

# H A N D B O O K

FOR  
T H E  
INDIAN SCIENCE CONGRESS  
PATNA SESSION  
1 9 4 8

## P R E F A C E

This handbook is intended for the use of members and delegates attending the thirty-fifth session of the Indian Science Congress at Patna. It contains, within a comparatively brief compass, a history of the province and its people, its culture and antiquities, together with an account of its more important industries and enterprises, its educational activities and other particulars which are likely to be of interest to the visitors.

We take this opportunity of expressing our thanks to the authors, who have contributed articles to this volume and whose names appear in the table of contents. We are thankful to the Geological Survey of India for the geological map and the Survey Office, Gulzarbagh, for the map of Patna and also to the Tata Iron & Steel Company, the Indian Science News Association, the Rohtas Industries and the Directors of the National Metallurgical and Fuel Research Institute for their valuable and ready help in connection with the printing of the handbook.

Our thanks are also due to the Ajanta Press, Patna, who have spared no pains in the publication of this volume.

B. N.

P. B. G.

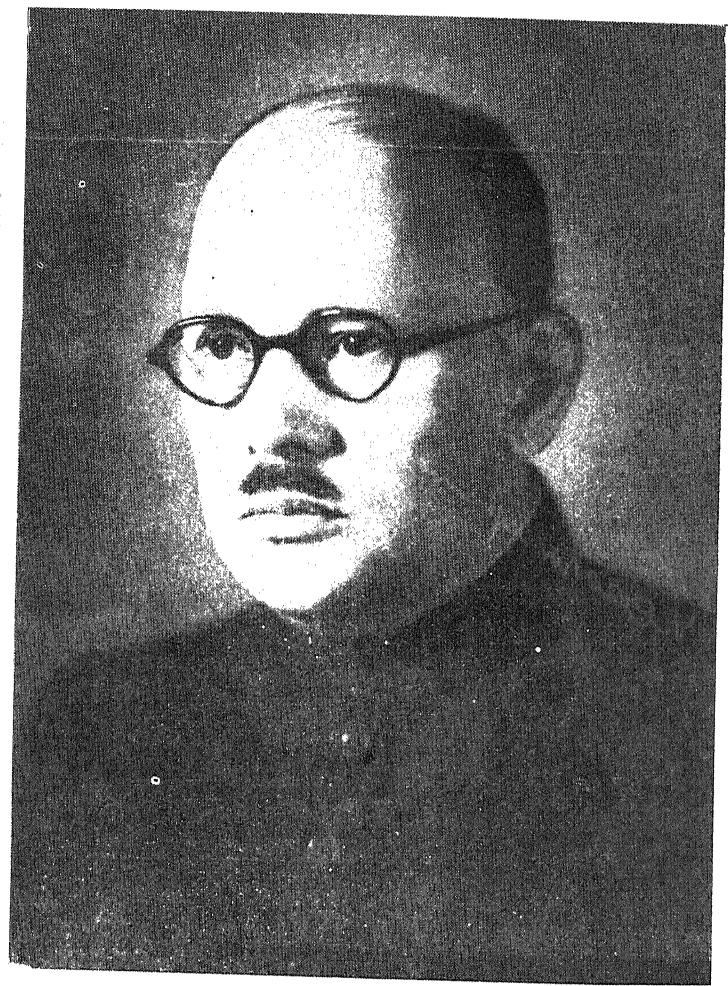


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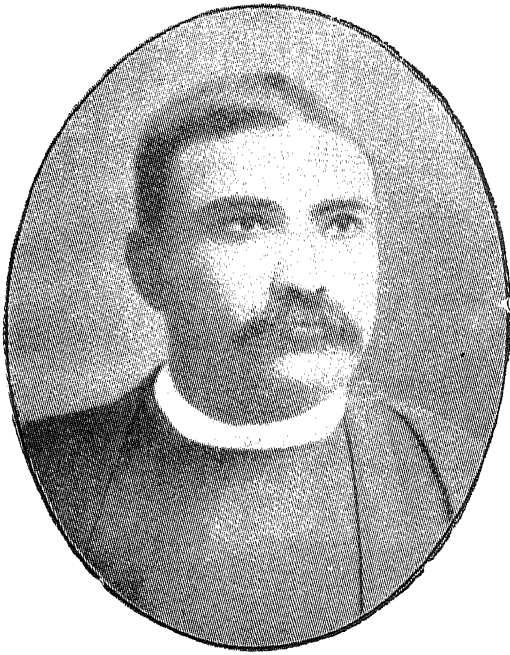


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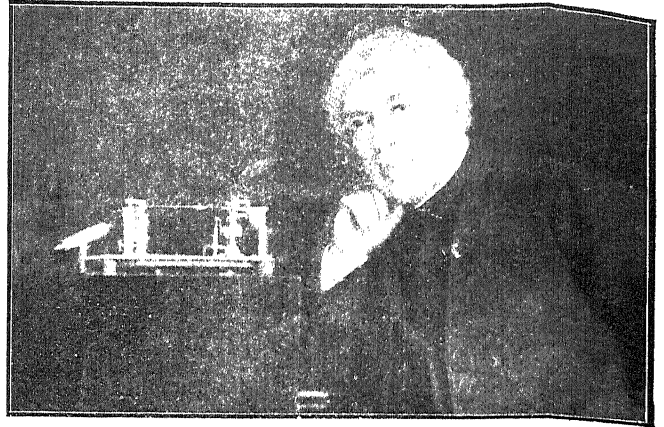


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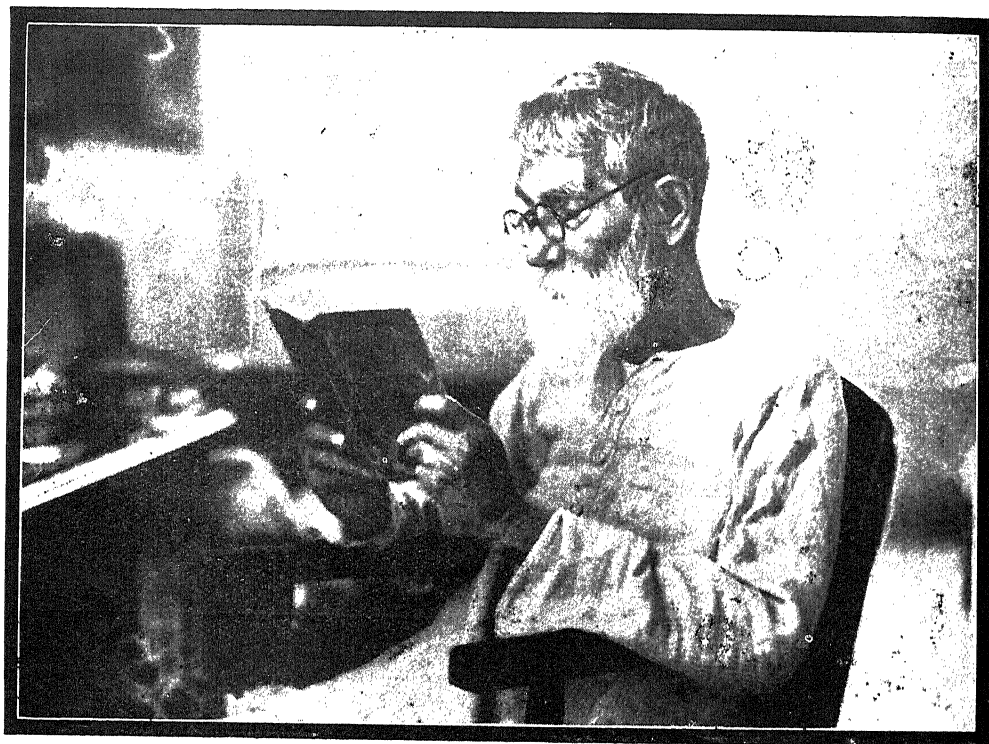


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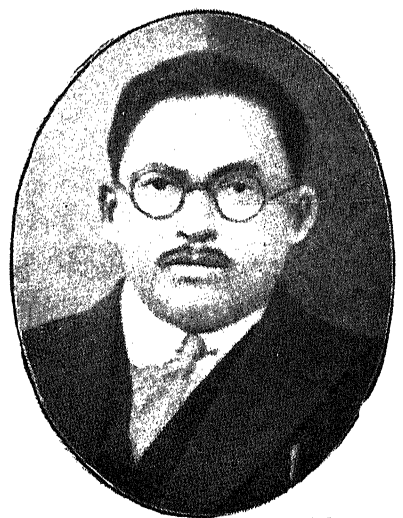
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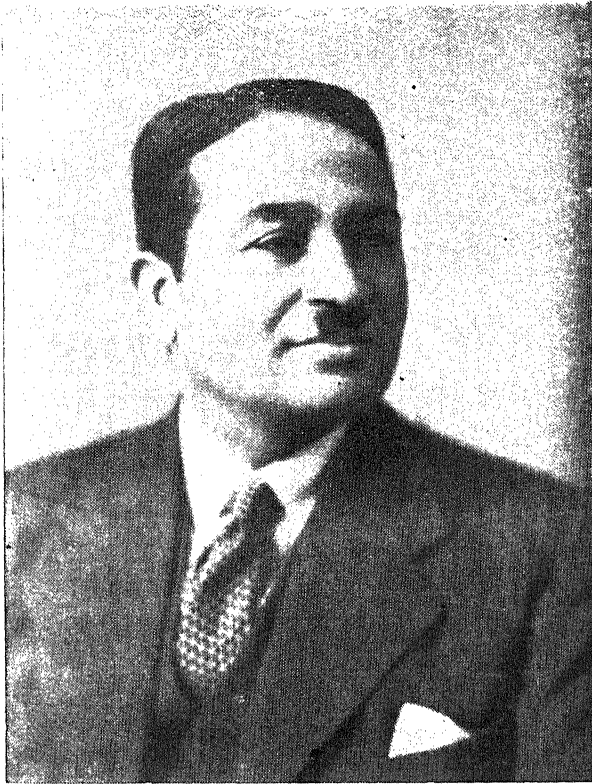
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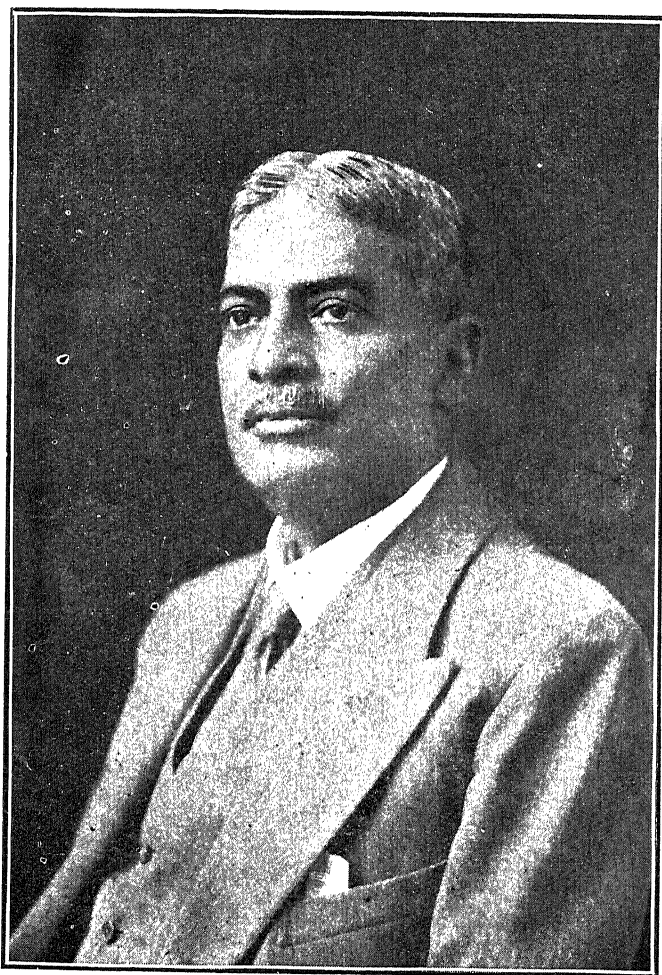
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# HISTORY AND ANTIQUITIES OF BIHAR

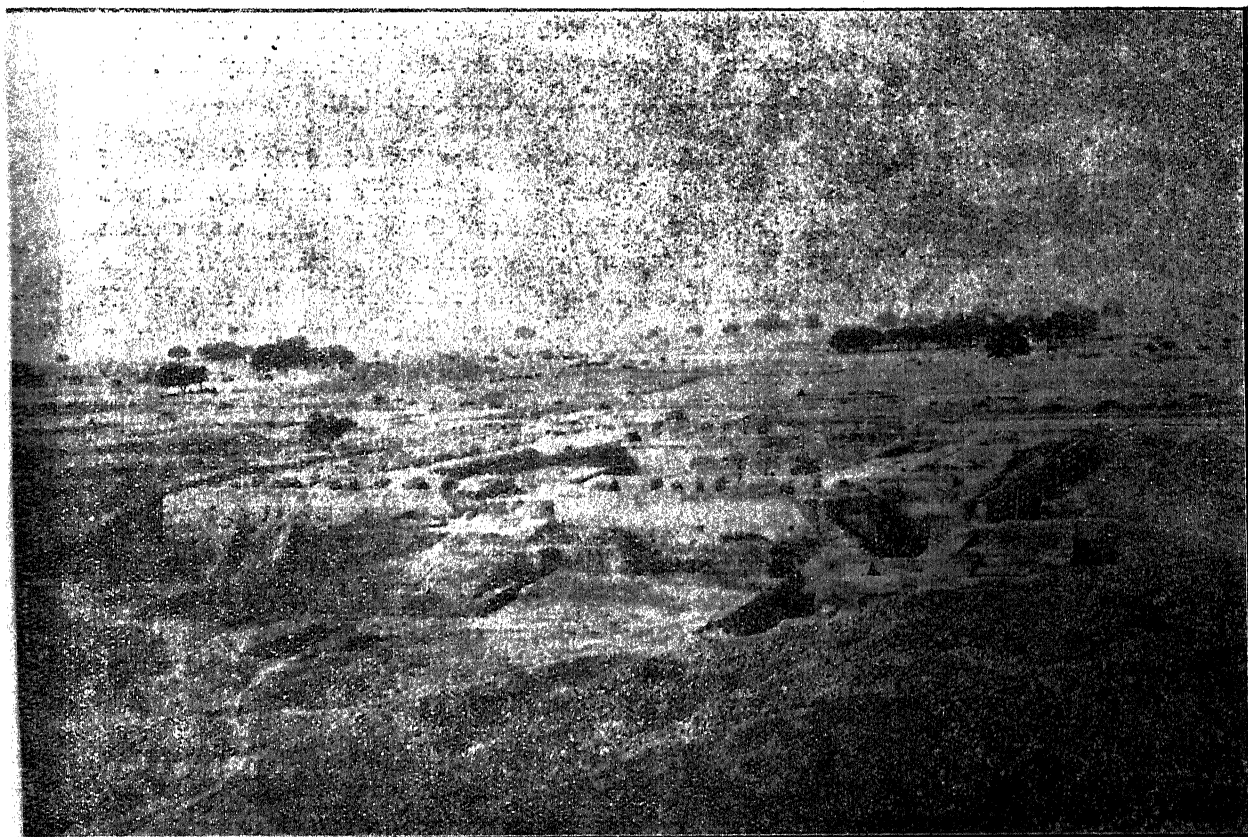
*By*

Dr. Kalikinkar Dutta, M.A., P.R.S., Ph.D.

## ANCIENT BIHAR

From Janaka to Asoka

An important centre of civilisation since the days of remote antiquity, Bihar has played a prominent role in the history of India age after age. Hardly any other province can claim to have made the same contributions to the politics and culture of ancient India as Bihar. This land was the centre of activities of great kings like Janaka and Asoka, who hold unique records for their noble ideals and humanitarian achievements, revolutionary thinkers and religious leaders like Gautama Buddha and Mahavira, and eminent publicists as well as statesmen like



Nalanda Monastery

Vajnavalkya and Chanakya. In ancient Bihar flourished that celebrated Nalanda University of international importance, which not only attracted to its seminaries scholars from foreign lands but also sent out to the far-off regions its *alumni*, proficient in the varied branches of human lore. Politically it saw the rise and growth of some powerful kingdoms such as Mithila, Magadha, Anga, and the most typical ancient republic with its capital at Vaisali.

In ancient literature for the first time Mithila, the capital of Videha, is mentioned in the Jatakas and the Epics. It has been identified with the small town of Janakpur just within the Nepal border. The kingdom of Mithila or Tirhut was bounded on the east by the Kausiki, on the west by the Gandaka, on the south by the Ganges, and on the north by the Himalayas. Roughly speaking, the kingdom of Mithila covered the whole of the modern Tirhut Division excepting some parts of Saran and Champaran districts.

Among the brilliant series of ancient Mithila monarchs the most famous is Janaka, who was the contemporary of Aruni and Vajnavalkya. Evidently under him Mithila was a very important centre of learning, in general and philosophy in particular. Under his successors in the 7th and 6th centuries B. C. Videha was counted as one of the sixteen *Mahajanpadas*. In the fifth century B.C. the kingdom of Videha was absorbed by the Magadhan imperialism.

According to the Puranas and the Ramayana, south-west of the kingdom of Mithila was the kingdom of Vaisali. Vaisali was originally a monarchy. It was founded by Visala who, according to the Puranas and the Ramayana, was a scion of the Ikshvaku dynasty. This kingdom was overthrown some time before the 6th century B. C., as no mention of any monarchical rulers of Mithila and Vaisali is made in Buddhist records depicting Buddha's time. The change from monarchy to the republican form of government probably took place in the 6th century B. C.

The Vajji confederacy with its capital at Vaisali was one of the prominent states of Northern India in the 6th century B.C. The Vajji included eight confederate clans of whom the Videhans, the Lichchhavis, the Jnatikas and the Vajjis proper were the most important. The Videhans had their capital at Mithila (Janakpur), the Jnatikas, to which belonged Siddhartha and his son Mahavira the Jina, had their capital at Kundagrama (near Vaisali), and the Lichchhavis at Vaisali, identified with Basarh (to the east of Gandak in the Hajipur subdivision of the Muzaffarpur district). The Vajjis gave their name to the entire confederacy, although they were one of the constituent units.

The Vajji confederacy was not a passive spectator in the struggle for supremacy between Magadha and Kosala. Probably because of racial affinities they extended their support to the Kosalan king against Magadha and also a common front against the advance of the Magadhan imperialism lay in their common

interests. A struggle between the rising monarchical state of Magadha and the powerful republican confederate state of Vaisali, lying on the opposite bank of the Ganges, was inevitable. Tradition asserts that in the time of Bimbisara, king of Magadha, the Vaisalians invaded their neighbours across the Ganges. It was Ajatasatru who weakened the Vajjis by sowing dissensions among them, invaded their land, destroyed their independence and incorporated their territories into the expanding Magadhan kingdom. Although their independence was destroyed by Magadha, their democratic and constitutional practices as well as procedures were the cherished treasures of Indian history.

### ANGA

The monarchical state of Anga, situated east of Magadha, was separated from it by the river Champa. Its capital Champa has been identified with Champanagar near Bhagalpur. Down to the time of Gautama Buddha's death, it was considered to be one of the six great cities of India. It was noted for its wealth and commerce, and merchants sailed from Champa down the Ganges to Suvarna-bhumi and Champa (modern Cochin China). Magadha and Anga struggled hard for supremacy. Anga at first triumphed and annexed Magadha, and a Jataka describes Rajagriha as the city of Anga. Brahmadatta, king of Anga, defeated the contemporary Magadhan king. Bimbisara finally annexed Anga to Magadha by killing Brahmadatta. He remained as viceroy at Champa till his father's death.

### MAGADHA

With its two ancient capitals at Girivraja and Pataliputra, Magadha has a unique history. On the basis of some pre-Aryan terracotta figures found in the compound of the Patna College, and what we know of the Vratyas from the Atharva Veda it can be said that Magadha was one of the oldest seats of civilisation in India, as old as what is called the Indus-Valley civilisation. There are similarities between the religious practices of the Vratyas and the Indus-Valley people—particularly in the worship of the deity who has been identified as Shivamaheshwara in the Indus valley. Future archaeological excavations in Magadha might establish a link between old Magadhan civilisation and the Indus-Valley civilisation.

The history of Magadha came to acquire special importance from the 6th century B. C. It was an important centre of activities of Mahavira and Buddha. Mahavira spent a large part of his life here and breathed his last at Pava (Pawapuri) near the modern town of Bihar Sharif in the Patna district. Gautama Buddha in search of knowledge sat at the feet of great scholars of Rajagriha and finally obtained supreme knowledge at Bodhi Gaya, a city of Magadha. Two of the Buddhist councils were held in Magadha, at Rajagriha and Pataliputra, and the Jains also held a great council at Pataliputra. Jainism and Buddhism both secured

royal patronage in Magadha. Famous seats of learning flourished within the limits of Magadha at Nalanda and Oddantapuri. In short, Magadha had an unparalleled history, culture and civilisation in its palmy days.

The earliest ruling dynasty of Magadha was that founded by Brihadratha, the son of Vasu Chaidya-Uparichara, and the father of Jarasandha. According to the Ramayana, Vasu founded the city of Girivraja or Vasumati (Rajagriha), remains of the fortifications of which are still found in modern Rajgir. They are the earliest remains of fortifications in India except those found in the Indus valley. In the 6th century B. C. the Brihadratha dynasty was overthrown and a new dynasty came into power. With this dynasty begins the rise and progress of Magadhan imperialism which is the capital fact of Indian political history for three centuries from the 6th century B. C. onwards. It is generally held that the founder of this dynasty was Bimbisara, who annexed Anga by defeating Brahmadatta and 'launched Magadha into that career of conquest and aggrandisement which only ended when Asoka sheathed his sword after the conquest of Kalinga'. He strengthened the infant Magadhan imperialism by entering into matrimonial alliances with his neighbours, Madra, Kosala, and Vaisali, and by maintaining friendly relations with Avanti and Gandhara.

Bimbisara is said to have been killed by his son Ajatasatru, who seized the throne. Ajatasatru proved to be a strong imperialist. He defeated the Kosala king, Prasenajit, in a war and gained the hands of a Kosalan princess with Kasi village. He also defeated and annexed the Vajji republic of Vaisali. The annexation of Kasi and Vaisali brought the Magadhan state face to face with the equally ambitious state of Avanti. This had a great influence on the subsequent policy of Magadha. It was during the reign of Ajatasatru that Buddha and Mahavira are said to have attained Nirvana, and a Buddhist council was held at Rajagriha.

Buddhist and Jain writers assert that Udayi was the son and successor of Ajatasatru. Udayibhadra, probably out of fear of Avanti's aggression, transferred the capital to Pataliputra on the confluence of the Ganges and the Sone, where Ajatasatru had constructed a fort as a base of operations against the Lichchhavis.

After Udayi, Magadha's history is rather obscure. According to Buddhist sources Udayi's successors were Aniruddha, Munda and Nagadasaka, all incapable and parricides. The citizens became indignant, banished the last ruler and an 'amatya', Sisunaga by name, was raised to the throne. Sisunaga exterminated the power of the Pradyotas of Avanti and extended the limits of the Magadhan empire up to the western seas.

Sisunaga was succeeded by Kalasoka or Kakavarana in whose time the second Buddhist council was held at Vaisali. He retransferred the capital



Didarganj Image—Found in 1917 at Patna.

[ To Face Page 5



permanently from Girivraja to Pataliputra. The king met a tragic end with a dagger thrust into his throat in the vicinity of a city which may have been Pataliputra, Vaisali, or some other important city in the kingdom.

Kalasoka was succeeded by ten other kings under whom Mahapadma Nanda enjoyed real power as their guardian. He overthrew the last of them and founded the Nanda dynasty. He was a great conqueror who uprooted the Kshatriyas and extended the limits of his dominion far and wide. His conquest of Kalinga is probably referred to in the Hathigumpha inscription of Kharavela where Nandaraja can be more probably identified with Mahapadma Nanda Ugresena, the founder of the Nanda dynasty. Several Mysore inscriptions state that Kuntala, a province covering the southern part of the Bombay Presidency and the north of Mysore, was ruled by the Nandas. The extent of Nanda rule over a considerable part of the Deccan is suggested by the existence on the Godavari of a place called Nau Nand Dehra (Nander). Mahapadma Nanda can be regarded as the first historical paramount ruler of India.

Mahapadma Nanda was succeeded by his eight sons who were kings in succession. The last king, Dhanananda, was ruling at the time of Alexander's invasion, and it was the rumour about the might and wealth of this Indian ruler that made the Macedonian invader retreat from India.

The Nanda dynasty was overthrown by Chandragupta Maurya, a scion of the Maurya (Moriya) clan at Pippalivana, with the help of Chanakya and Chandragupta succeeded to the vast dominion of Magadha empire and made new additions to it. Chandragupta Maurya, the founder of the Maurya dynasty, liberated the north-western part of the country from foreign (Macedonian) yoke. The attempt of Seleukos to recover the lost territory was foiled by him in 305 B.C. and the Greek ruler had to cede the province to the east of the Hindukush to the Mauryan empire whose boundary in the north-west thus reached its scientific frontier. Chandragupta was a great conqueror and he brought the whole of northern India and large parts of peninsular India under his sceptre. Relying on the account of a Tamil writer Mamulanar, Dr. Krishnaswami Aiyangar holds that Chandragupta carried his victorious arms up to Podiyil Hill in the Tinnevely District. Chandragupta's rule in North Mysore is referred to in certain Mysore inscriptions, and Surashtra in western India was definitely a part of his dominion.

Chandragupta reigned for about 24 years. His last days were not happy. According to Jaina tradition, he became a Jaina and when a great famine occurred he abdicated his throne in favour of his son, and retired to Mysore where he died. The extent of the Mauryan empire seems to have remained undiminished during the reign of Bindusara who ascended the throne about 302 B. C. We do





Buddha in Abhaya mudra

not know definitely whether he made new conquests. He is credited with the suppression of a rebellion in Taxila, and also with the extension of empire in the south.

Bindusara died about 273 B. C. and was succeeded by Asoka whose reign forms one of the most glorious epochs in the history of humanity. Asoka was coronated in 269 B. C. and during the first thirteen years of his reign continued the traditional Maurya policy of expansion within India and of friendly relations with the foreign powers.

Asoka's greatest political achievement was the conquest of Kalinga. The Magadhan empire under Asoka covered the whole of India except the far south.

It included the areas roughly covering modern Beluchistan and Afghanistan which even the British government of India could not completely conquer. Thus, for the first time under the Magadhan empire of the Mauryas, India attained her political unification on the largest possible scale.

The Kalinga war proved to be a turning point in the career of Asoka. It introduced a momentous change in the Maurya policy by substituting Dharma-vijaya for Digvijaya. It is a unique example in the history of the world that a conqueror after a resounding victory decided to eschew further conquests at a time when the arms of Magadha could very easily embrace the extreme peninsular India and tribal areas on the frontiers. Henceforth the entire administrative machinery of the Maurya state began to be used in propagating true spirit of Dharma—religious toleration and welfare of the people not only in the Mauryan empire but also outside its boundaries even to the distant Hellenistic kingdom of Syria, Albania, Cyrene, Egypt, and Macedonia. Ceylon and Burma also received the cultural and religious missionaries of Asoka. From his seat at Pataliputra the greatest of kings, Asoka, sent out the first royal missionaries of international peace and co-operation to different parts of the world, an act which the present world is still dreaming of.

After Asoka the Mauryan Empire began to decline. Its real causes were the weakness of the successors of Asoka and the oppressive rule of the provincial governors. Asoka's responsibility for the fall of the empire is at best indirect

inasmuch as his peace policy after the Kalinga war led to the ultimate weakening of the powerful military organisation which failed to repel the Greek invaders.

The history of the Mauryan dynasty after the death of Asoka is uneventful. Among a number of kings, the name of Dasaratha deserves mention as a historical figure. The last ruler of the dynasty, Brihadratha, was assassinated by his general, Pushyamitra, who founded the Sunga dynasty about 187-186 B. C.

With the downfall of the Mauryas the political unity of India disappeared. The Sungas appeared to have failed to arrest the centrifugal forces which had full play till the advent of Samudra Gupta on the scene. Drs. Smith, Jayaswal and Professor Dubreuil hold that Kharavela of Kalinga was a contemporary of Pushyamitra Sunga. In the Hathigumpha inscription Kharavela is credited with large conquests and numerous victories in Southern and Northern India. He invaded Magadha twice and defeated its king in the battle of Gorathagiri (Barabar hills), harassed Rajagriha and approached Pataliputra. Drs. Majumdar and Roychowdhury hold that Kharavela could not be contemporary of Pushyamitra who ruled from about 187 to 151 B. C. Pushyamitra came out victorious in a war with his adversary, the ruler of Vidarbha or Berar.

According to Patanjali and Kalidasa, a Greek invasion of the Northern India occurred in the time of Pushyamitra. The invader occupied Saketa (Ayodhya), but the Yavana prince was defeated by Vasumitra, grandson of Pushyamitra, on the southern or right bank of the Sindhu (the Indus).

Pushyamitra performed two horse sacrifices. These have been regarded as marking the beginning of the Brahmanical revival which reached its culmination in the Gupta age. Pushyamitra was succeeded by his son Agnimitra in about 151 B. C. Many coins bearing the name of Agnimitra have been found. After him the history of the Sunga dynasty is obscure.

In 75 B. C. the imperial family of the Sungas was overthrown by Vasudeva, who founded the Kanva dynasty which continued to rule Magadha and neighbouring regions for about forty-five years. The last Kanva ruler was overthrown by the Satavahanas.

The Sunga period adds a bright chapter to the history of Indian art, religion and literature. Vidisa, Gonarda and Bharhut were the centres of these activities. Bhagavata religion was widely popular. Patanjali was the greatest literary genius of the time and the famous railing at Bharhut was constructed during this period. It is held that the famous *Manusmriti* was written during the same period.

Once again Magadha emerged into political prominence with the rise of the Guptas. The Guptas founded what may be called the second Magadhan empire.

The rise of the Gupta dynasty to imperial position began with Maharajadhiraja Chandragupta I. His marriage with Kumaradevi, the Lichchhavi princess, must have played an important part in the growth of the Gupta dominions. It is certainly obvious on the evidence of the coins bearing on the obverse the figures and names of Chandragupta and Kumaradevi and on the reverse a goddess seated on a lion along with the legend Lichchhavayah (Lichchhavis), that the matrimonial alliance with Lichchhavis contributed largely to the rising fortunes of the Gupta dynasty. The territorial extent of Chandragupta's dominions is not correctly known. It is very ambitious to identify him with the Chandra of Mehrauli Iron Pillar Inscription and thus to attribute to him extensive conquests of the north-western frontier and of whole of the country. What is definite is that his dominions included a greater part of Bihar and a portion of U. P. The Gupta era beginning from 320 A. D. is generally said to mark the accession of Chandra Gupta I.

Chandra Gupta I was succeeded by his son Samudra Gupta. He laid the foundation of the political and cultural greatness of the Guptas. He fought against nine named and many other kings of northern India and annexed their territories to his dominions. Then he penetrated into the Deccan and defeated twelve South Indian rulers, including Mahendra of Kosala and Vishnugopa of Kanchi. His military sway extended over the Central Provinces also, as is evident from the Eran inscription. His suzerainty was acknowledged by the frontier and insular kings who offered him homage and tribute or presents. He was a great patron of art and letters, and under his successor, Chandra Gupta II, the Hindu culture attained efflorescence. Just as Pali was the *lingua franca* under the Mauryas, so Sanskrit became the *lingua franca* under the Guptas.



Plaque, Bodh Gaya

## EARLY MEDIEVAL BIHAR

### Sixth Century A. D. to Muhammadan Conquest

With the decline of the Guptas as an imperial power, Bihar lost her independence and Pataliputra ceased to be the metropolis of India. Hiuen Tsang writes that it had become depopulated long ago. For some time Bihar became sandwiched between the Maukharis in the west and the 'Gaudas' in the east, and was even included in the dominion of Sasanka, extending from Kanauj to Ganjam in the south. Later on Magadha, and presumably Kajangala (round Rajmahal) were absorbed (641) in the Kanauj kingdom of Harsavardhana of Thaneshwar. But other parts of Bihar formed several independent and semi-independent states, e. g., (i) Hiranyaparvata (?), i.e., the country round Monghyr, and (ii) Champa or Bhagalpur district. The circumstances following the death of Harsa (646 or 647), the usurpation of the throne of Kanauj by his minister, Arjuna of Tirhut, and his subsequent defeat and capture by the Chinese ambassador to Harsa (according to Chinese annals), helped the extension of Tibetan influence for the first time in the Gangetic valley, including North Bihar. Early in the 8th century, this Tibetan yoke was thrown off by Adityasena, belonging to the later Gupta family of Magadha, who ruled over an area wider than Gaya, Patna, Bhagalpur, and Shahabad districts of Bihar, fought with Maukharis of U. P. and also waged wars on the banks of the Lauhitya. He and his three successors ruled over Magadha in the last quarter of the 7th and beginning of the 8th century and assumed imperial titles.

But this revival of the glories of Bihar was only short-lived. In the first half of the 8th century both Bihar and Bengal became subject to foreign invasions. Yasovarman of Kanauj defeated the powerful ruler of Magadha-Gauda, whose dominions extended from the borders of Vanga (East Bengal) to the Vindhya. Subsequently came the Kashmir kings, Lalitaditya and Jayapida, and Sri Harsa of Kamarupa.

The period of anarchy ended with the rise of the Palas. They were the last imperial rulers, who issued their commands from the city of Pataliputra, which then regained its former glory to some extent.

Under the Pala hegemony Bihar came to be not only linked up with Bengal, but also to be ultimately involved in all-India politics. The first Pala king, Gopala, brought Magadha under his control. His son, Dharmapala, set up a camp of victory at Pataliputra, and established his imperial position in north

India, installing his nominee Chakrayudha in place of Indrayudha on the throne of Kanauj. During the shifting courses of the so-called 'tripartite' conflict between the Palas, the Pratiharas and the Rashtrakutas, Bihar became the scene of marches and counter-marches of contending armies. Dharmapala, defeated by Nagabhata Pratihara at Monghyr, sought alliance with Rashtrakutta Govinda III, who routed the Pratiharas. Taking advantage of the weakness of his western and southern rivals, Devapala regained for Bihar and Bengal their pre-eminent position in North India and even led an expedition to the far south. Frequent issue of grants from Monghyr shows that probably Monghyr was the capital of the Palas.

In the second half of the 9th century and the beginning of the 10th, the Pala rulers were weak, and presumably there was internal disorder in their kingdom. This excited Rashtrakuta aggression and their western rivals, the Pratiharas, brought under control the whole of North India from the Punjab to Gujrat and the Pala dominions in the east. Inscriptional evidence indicates that a large portion of Bihar, including at least Gaya and Hazaribagh districts, the whole of Tirhut and North Bengal as far Paharpur came to be occupied by the Pratiharas. The districts of Patna, Monghyr, Bhagalpur and the Santal Parganas in Bihar to the south and parts of the west, east, and south Bengal were still occupied by the Palas. But soon the Pratiharas were overpowered by their rivals, the Rastrakutas. Taking advantage of this the Palas recovered their power and regained Gaya district (c. 935-92), though they lost North Bengal (Gauda) to the Kambojas (c. 911-92). Mahipala (c. 988-1038), who restored the fortunes of the Palas, ruled over Gaya, Patna, and Muzaffarpur districts in Bihar and probably over Tirhut and also up to Benares and came into conflict with the Kalachuri ruler, Gangeyadeva (1019-26).

Bihar escaped from the northern invasion of Rajendra Chola (c. 1025). Nayapala (c. 1038-55), ruling over some parts of Bihar (including Magadha) and North Bengal, came into conflict with the rising power of the Kalachuris of Tripuri. The Chalukyas of Kalayana (1044-68) also invaded North India. Many South Indians now came along with them; the rise of the Karnatakas of Tirhut and Nepal and of the Karnata-Kshatriyas (the Senas) of Radha in the 11th century are to be connected with these invasions of the southern powers. In the later half of the eleventh century the Pala power began to decline. With the rise of the Kaivartas and the death of Mahipala II (1070-75), Pala influence came to be confined only to a portion of Bihar and the northern part of the Presidency Division; and some local chieftains asserted their influence. But Ramapala, the youngest brother of Mahipala II, effected a temporary restoration of the power of his family. He defeated a Magadha feudatory and by winning over his Samants and the forest chiefs, and raising a powerful army, he crushed the power of the Kaivartas. He is also said to have conquered Utkala, Kalinga and Kamarupa.

After the death of Ramapala, the hold of the Palas over Bihar became looser than before. A Brahmin family, whose inscriptions of the second half of the 11th century have been found at Gaya, now rose to independence and assumed royal titles, while the mercantile family of the Manas became independent in the Hazaribagh district. The Pala king now ruled over a very circumscribed area, extending from Patna to Rajmahal, along the southern bank of the Ganges and over a part of North Bengal.

During the reign of Madanapala (first half of 12th century), Bihar seems to have been cut off politically from Bengal by the rise of the Senas, who had once been Pala feudatories.

The Senas came into conflict with the Karnataka Nanyadeva of Mithila (c. 1097-1150), who had conquered Bengal from the Palas probably during Mahipala's reign. In the second half of the 12th century, the Senas not only maintained their hold on Mithila but even advanced westwards. The district of Patna and Monghyr constituted the sole remnant of the Pala dominions now. If the Senas came from the east, the Gahadavalas came from the west. In the first half of the 12th century A. D. they advanced into Bihar as far as Maner and Monghyr. In the second half of the 12th century A. D. they occupied Shahabad, Patna and Gaya. Attacked from both flanks, the decaying Pala power was crushed out of its existence. Lakshmanasena drove out the Gahadavalas from Magadha and even proceeded up to Benares and Allahabad.

Towards the end of the 12th century, Bihar had no ruler of importance. The Gahadavalas retired from there after the fall of the Chauhan in 1192, and the Palas became virtually extinct as an effective power. The jurisdiction of the Palas, if it survived at all, came to be limited to modern Bihar subdivision, site of the university town of Uddandapur (Bihar).

## BIHAR DURING THE TURKO-AFGHAN PERIOD

Ikhtiyar-ud-din Muhammad ibn Bakhtiyar, a Turk of Ghur, made repeated incursions into Maner and Bihar from his base in his fiefs between the Ganges and the Karamnasa. He finally captured the "fortified city" or University town of Bihar, and slew its shaven-headed Buddhist ascetics, mistaken for Brahmins. Thus he destroyed the famous Nalanda University and dealt a mortal blow to Buddhism in India. Ikhtiyar-ud-din is said to have captured the monastic cities of Vikramasila and Nalanda and set up a fortress on the site of Uddandapur. Probably Lakshmanasena had posted forces on the military road from Bihar to Bengal passing through the Rajmahal hills. But Ikhtiyar-ud-din marched (1204-5) through the difficult Jharkhand area and raided Nadia, then held by Lakshmanasena.

Bihar soon became a part of the vast Muslim dominions, extending from Ghazni in the west to Gaur in the east. For the first time its fortunes became linked with the ups and downs of the Delhi Sultanate. But the control of Delhi over the eastern provinces, including Bihar, was fitful. After Qutubuddin's death, Bihar passed out of the hands of the Delhi government. Bihar, south of the Ganges, was recovered by Iltutmish, and Darbhanga was also conquered by him; but it is doubtful if this resulted in permanent occupation.

During the rule of Iltutmish's successors, Bihar was a part of Bengal province. For the next few years, the history of Bihar is confused. An inscription at Barahdari, Bihar (1264), records the construction here of a tomb by Tatar Khan, son and successor of Arshan Khan, governor of Karrah, who had forcibly occupied Lakhnauti.

The hold of the Delhi Sultanate on South Bihar was not quite extensive. It controlled only a narrow littoral south of the Ganges, through which the route from Benares to Bengal passed *via* Shahabad, Patna, Bihar, Monghyr and Bhagalpur districts. To its south, independent Hindu princes, surviving the domination of the Senas and the Gahadavalas, held sway. While the Pithipatis ruled as vassals of the Turks in the 13th century, inscriptions of Kumaon (e. g. Asokacalla) and Siwalik chiefs round Bodhgaya (of 12th or 13th century) testify to continuous Hindu occupation of the Gaya district. In any case the contemporary chronicles do not refer to extension of Muslim power over the south. Even the town of Bihar again fell under Hindu control. Early in the reign of Nasir-ud-din Mahmud, governor Kureet Khan lost his life in repelling a siege of the whole of Bihar. However, by 1265, Bihar was recovered by the Turks, and epigraphic evidence

states that Balban's suzerainty was recognised in Gaya, but it was not directly annexed to his dominions. Among the security measures of Balban to suppress the prevailing anarchical conditions in Northern India must be mentioned the establishment of military posts, manned by Afghans, at Bhojpur, then a stronghold of rebels. Tughril rebelled in Bengal and defeated the royal forces ( under Amin Khan, governor of Oudh ) near the Gogra in North Bihar.

Under the Tughluq dynasty, the Raja of Tirhut, the last representative of the Karnataka dynasty, was defeated. Tirhut was annexed to the Sultanate, and Muhammad-bin Tughluq suppressed a rebellious local chieftain. He also issued coins from the mint of Tughluqpora *alias* Tirhut. But Bengal again became independent under Haji Ilyas ( Shams-ud-din Ilyas Shah ) about 1345. Firuz Tughluq undertook two expeditions (1353-54, 1359-60) to bring it under control, which, however, proved to be abortive.

Towards the close of the 14th century ( 1394 ), Bihar became a part of the Sharqi kingdom of Jaunpur. The Afghan Sultan, Sikandar Lodi, crushed the Sharqis of Jaunpur and annexed Bihar ( 1495 ), ordered his eldest son, Ahmad Khan ( Azam Humayun ), to realise tribute from the chieftains of Tirhut and entrusted Darya Khan Lohani with the government of Bihar.



Sher Shah's Tomb.



## BIHAR DURING MUGHAL RULE

From the first battle of Panipat in 1526 to the second battle of Panipat in 1556 there raged a long contest for Mughal-Afghan supremacy in India, and Bihar came to be involved in it. After the defeat of Ibrahim Lodi by Babar at Panipat in 1526, the Afghans of Bihar rallied round Mahmud Lodi, brother of Ibrahim Lodi. But on the approach of Babar, many Afghan chiefs submitted to him and Mahmud had to take refuge with Nusrat Shah of Bengal. The Afghans were defeated in the battle of the Gogra fought near its junction with the Ganges above Patna ( May 1529 ). Humayun defeated the Afghans at Daurah ( August, 1532 ) and expelled Sultan Mahmud from Jaunpur when the latter fled to Patna and to Bengal. He also besieged Chunar ( 1533 ), then held by the Afghan chief, Sher Khan, but instead of thoroughly suppressing him secured 'purely perfunctory submission'.

For a long time under Sher Shah Bihar became the centre of all-India politics. Sassaram formed his training ground, as he governed the two parganas of Sassaram and Khawaspur dependent on Rohtas. Some time afterwards he entered the service of Bahar Khan Lohani, the independent ruler of Bihar. Subsequently, as guardian of his minor son, Jalal Khan, Sher made himself the virtual dictator of Bihar and saved it from being absorbed by Nasiruddin Nusrat Shah of Bengal whom he defeated ( 1529 ). Jealous of his growing power, the Lohanis formed a confederacy against him in alliance with Jalal Khan and Mahmud Shah, ruler of Bengal. But he defeated (1534) the allied troops at Surajgarh on the bank of the Kiul river, east of the town of Bihar. This victory made Sher Shah the independent master of Bihar. Later on he secured from the Bengal ruler the territory from Kiul to Sikrigali. In 1537 he even blockaded the city of Gaur. The Afghan menace in Bihar led Humayun to march against him, but the imperial forces were defeated by Sher at Chaunsa near Buxar ( June 1539). His dominions now extended from Kanauj to the Bay of Bengal and the hills of Assam and from the Himalayas to Jharkhand (Rohtas to Birbhum). Next year he crushingly defeated Humayun (May 1540), and thus established the supremacy of Bihar over Hindustan. Bihar again exercised a dominating influence over the politics of North India, for the first time since the Guptas. In 1541 Sher Shah transferred the capital of Bihar from the town of Bihar to Patna, which consequently rose into prominence. He fortified it duly. The author of *Tarikh-i-Daudi* writes :

"Sher Shah, to whose foresight must be ascribed the foundation of the city of Patna, on his return from Bengal in 1541 came to Pattana, then a small town dependent on Bihar, which was the seat of the local government. He was standing on the bank of the Ganges, when, after much reflection, he said to those who



Baber's Rejoicing at birth of Humayun

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were standing by :— “If a fort were to be built in this place, the waters of the Ganges could never flow far from it, and Pattana would become one of the great towns of this country.’ He ordered skilful carpenters and bricklayers to make immediately an estimate for building a fort at the place where he stood. These experienced workmen submitted an estimate of five lakhs which on the spur of the moment was made over to trustworthy persons. The fort was completed and was considered to be exceedingly strong. Bihar city from that time was deserted and fell to ruin; while Pattana (afterwards Patna) became one of the largest cities of the province.”

Down to 1563, Northern Bihar (with Hajipur as its capital) was held by the Sur Afghans and South Bihar (with Bihar Sharif as its capital) was under an Afghan named Sulaiman Kararani. On the murder of Jalal Shah Sur, the Kararanis under Sulaiman became supreme over the whole of Bihar and Bengal (1564), and also conquered Orissa. However, he acknowledged the suzerainty of Emperor Akbar. But later on his two sons Bayazid and Daud successively asserted independence of the Mughals. The latter even attacked the frontier Mughal fort of Zamania in Ghazipur district. Emperor Akbar personally led an expedition against him, captured Patna and Hajipur (1574), drove the Afghans up to Barh and appointed Munim Khan governor of Bihar (capital Patna), instructing him to chastise Daud with the co-operation of Raja Todarmal. These two officers captured Surajgarh, Monghyr, Bhagalpur, and Colgong, and received the submission of the Rajas of Kharagpur and Gidhaur and of other local landholders. The Afghans were crushed and driven to Jharkhand. In 1575 the area extending from the ferry of Chaunsa to the Teliagarhi pass was formed into the separate province of Bihar. Daud Khan made a bid to regain Bengal, but was defeated and killed in a battle near Rajmahal (July, 1576) by Husain Quli Khanjahan, governor of Bihar, who was helped in this task by the governor of Bengal.

The conquest of Bengal by the Mughals did not mean the end of the Afghan menace for them. During the critical years of 1580-1, there was a rebellion of the Mussalmans in Bengal and Bihar as a protest against Akbar's revenue, military and religious regulations. Raja Todar Mal, deputed to suppress the rebellion, was for a time besieged at Monghyr. The rebellion was, however, suppressed. About the same time Prince Salim openly rebelled against his father, misappropriated Bihar revenue worth thirty lakhs of rupees, occupied the tracts as far as Hajipur and Patna and assigned them as jagirs to his leading supporters.

The Hindu Rajas of Bihar also made repeated endeavours to throw off the yoke of the Mughal rule. In the reign of Akbar, Raja Gajjan Sahi, the Ujjainiya chief of Bhojpur, organised a revolt which was suppressed with difficulty. This was followed by the occupation of Rohtas and Shergarh by the imperialists.

When Aurangzeb came to the throne he sent an imperial *farman* conferring

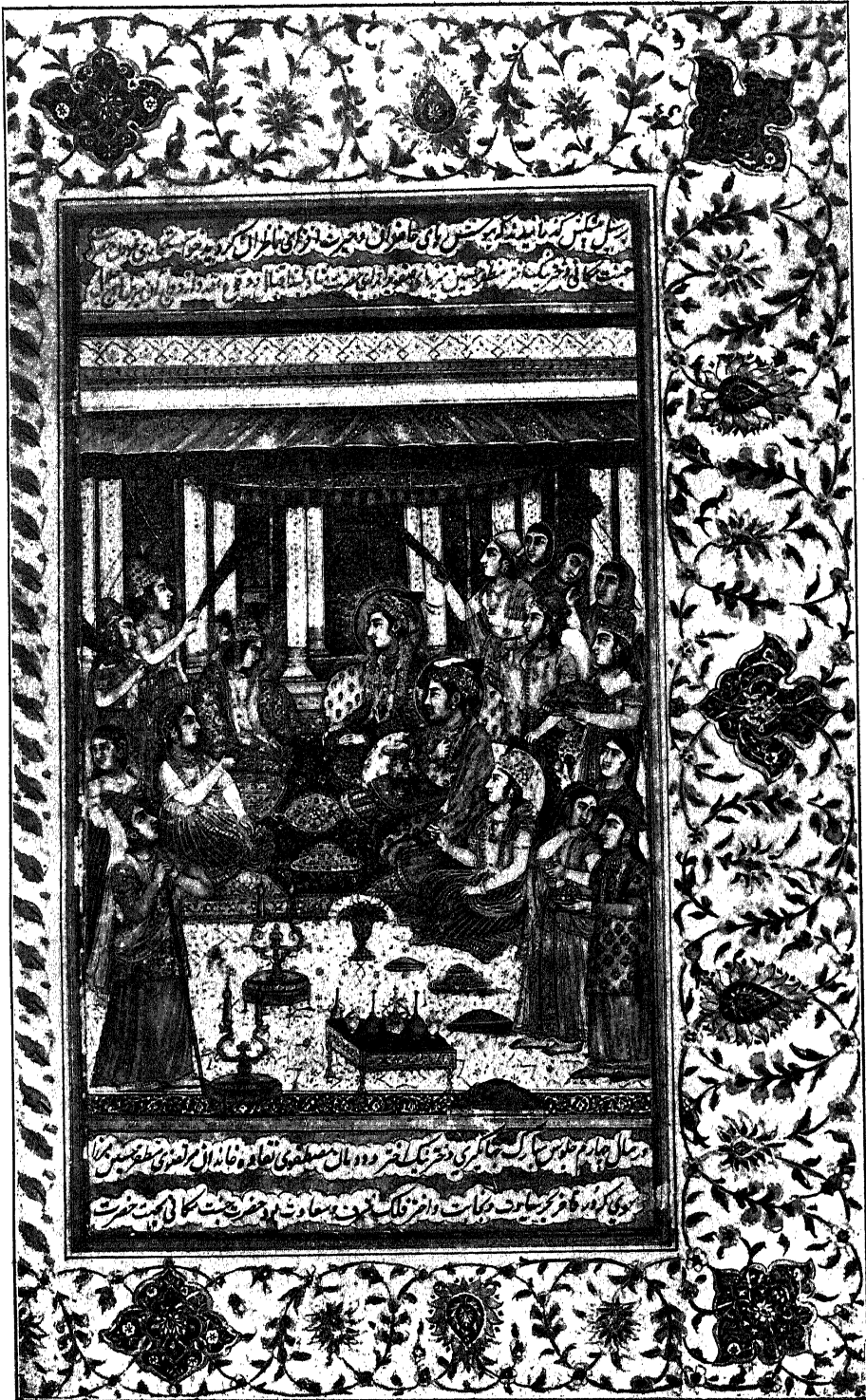
on Shuja the viceroyalty of the whole of Bihar in addition to that of Bengal. But this union was temporary, lasting only for a few months. Soon Bihar was placed under a separate Subahdar in 1659. The Bihar Government helped Mir Jumla, the imperial general, in his campaigns against Shuja, with men (including the Afghans and the Pahalwans of North Bihar), boats and some necessary materials for warfare. Bihar was very much influenced by the war of succession among the sons of Shahjahan. The province became the scene of marches and counter-marches of imperialist forces and Shuja's army. Peace came to Bihar when Shuja had been vanquished by Mir Jumla, who in 1650 was appointed the governor of Bengal only, but he exercised some control over Bihar.

The 17th century was marked by the suppression of some powerful semi-independent chieftains in Bihar by the Mughals, and the extension of Mughal rule in Chota Nagpur. Under Jahangir Raja Sangram of Kharagpur rose in rebellion but it was put down. In the time of Shah Jahan, the Raja's son embraced Islam and distinguished himself in distant campaigns. The Raja's grandson helped the imperial forces under Mir Jumla against Shuja. The powerful Ujjainyas of Bhojpur (Shahabad) proved to be a source of trouble to the Mughal empire. Though chastised under Jahangir they rebelled again. The rebellion was so serious that the governor of Bihar had to take the help of the governor of Allahabad and the *jagirdar* of Gorakhpur to suppress it.

The reign of Jahangir witnessed the conquest (in 1615) of Kukradesh (Chotanagpur) and the acquisition of the diamond mines of the Ranchi district by the Mughals. Under Shahjahan Palamau in the Chotanagpur division was subjugated by the Mughals. But it was finally conquered under Aurangzeb, and its administration was entrusted to a *fauzdar*. The hilly country of Morang (north Purnea) was a source of frequent disorder. The country was conquered by Shaista Khan, governor of Bengal, in 1574.

Jahangir began the practice of appointing the royal princes to hold charge of the province of Bihar. Prince Parwez was the first Mughal prince to get this office, and the others who followed him were Sulaiman Shikoh, Azam and Azim-us-than. Parwez gave his name to Paleza (Parwezada) and built the Sangi (Patharki) Masjid at Patna. Prince Khurram (Shahjahan) rebelled against Jahangir (1624) and, after occupying Bengal and Orissa, demanded the surrender of Patna from Mukhlis Khan, Parwez's agent. He was joined by many local officers and jagirdars, and by Raja Narain Mal of Dumraon. But the prince was expelled from Bihar and Bengal by the imperialists and the last vestiges of his influence disappeared with the surrender of the fort of Rohtas (1625).

During the governorship of Nawab Ibrahim Khan (1668-73) a devastating famine swept over the country from Benares to Rajmahal, taking a toll of



Marriage of Shah Jehan.

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1,03,000 lives. The Nawab is said to have generously given 15,644 shrouds to the Muslims of Patna. During the governorship of Saif Khan (1680-82) a young pretender, impersonated as a son of Shuja, but was seized and imprisoned. Ganga Ram, wrongly described as a zamindar of Bihar but really an agent of Khan Jahān Jung, plundered Bihar Shariff and besieged Patna. Rudra Singh, the Raja of Buxar and Bhojpur and a successor of Raja Kokalat Shahi, also caused trouble to the Mughals.

The rule of Saif Khan (Mirza Safi), one of the best governors of Bihar under the Mughals (1628-32), was marked by peace, prosperity, and splendour. He erected lofty public buildings, a madrasa, a mosque and a sarai, and laid out a fair garden on the other side of the Ganges. He set up a town (Safabad) near Monghyr and a sarai near it. A big well was excavated there under his orders when Mukhlis Khan was the *fauzdar* of the town. Two Brahmins of Tirhut displayed their intellectual attainments before the Emperor.

Towards the close of Aurangzeb's reign, in the beginning of the 18th century, his grandson, Azim-us-shan became the *subadar* of Patna, which was renamed by the Emperor, at his request, Azimabad. Azim-us-shan established several *sarais* and charitable institutions.

In the period of the break-up of the Mughal empire, Bihar came to be joined to the subah of Bengal, which had become practically independent of Delhi control under Murshid Quli Jafar Khan, governor of Bengal (1703-27). In 1727 the governor of Bihar was dismissed and Bihar was annexed to the Bengal subah in the course of a few years. From 1733, for about 200 years (till 1912), Bihar remained as an appanage of Bengal. Alivardi, *fauzdar* of Rajmahal, was appointed deputy governor of Bihar. In 1734 the latter was elevated to the rank of 5,000 and given the title of Mahabat Jung by the Emperor. Alivardi established order in the province, which had been highly disturbed owing to the activities of some turbulent Zamindars and Banjaras. The latter were chastised with the help of the Ruhela Afghans. The Bhojpuri zamindars of Shahabad, Raja Sundar Singh of Tikari, and other turbulent Rajas were subdued. The semi-independent tribe of the Chakwars of Sambho (Begusarai sub-division) was suppressed. Alivardi's government in Bihar was efficient and financially sound.

To realise his ambition of being the sole subahdar Alivardi defeated and slew Sarfaraz Khan, the Bengal Subadar in 1740. He legalised his usurpation of the *masnud* of Bengal by securing the imperial sanction. He had an able lieutenant in his nephew and son-in-law, known as Nawab Zain-ud-din Khan Haibat Jung, who served as deputy governor of Bihar (1740-48). The latter successfully chastised the Ujjainiya zamindars of Bhojpur, e.g. Raja Horil Singh and Udwant Singh (great-grandfather of Kunwar Singh), and defeated the Raja of Ramgarh

He endeavoured to improve the administration of sarkar Tirhut, including Bhanwarah, the old capital of the Rajas of Darbhanga. He also tried to conciliate the Hindu and Muslim chiefs of the province. Some of the Bihar chiefs like Syed Hedayet Ali Khan (father of Ghulam Hussain, the historian of Patna) and Raja Sundar Singh of Tikari contributed their best to the good administration of the province. Besides being a capable governor, Haibat Jung was also a keen judge of merit, and reposed confidence in two Kayasthas, Raja Kirat Chand and Raja Ramnarain, both of whom later on distinguished themselves as men of letters and able administrators.

Haibat Jung rendered valuable services to his uncle in checking the repeated Maratha incursions and the rebellions of the Afghans of Darbhanga, which disturbed the peace of both Bihar and Bengal.

The first Maratha invasion under Bhaskar Pandit ended ingloriously for the Marathas, who had to retreat to the Deccan in December 1742. On this occasion Alivardi was helped by his nephew, Zain-ud-din Haibat Jung, who joined him from Patna, and by Saif Khan, who went from Purnea. But Alivardi had appealed to the Emperor for help against the Marathas. So Safdar Jung, governor of Oudh, came in compliance with the Emperor's order, ostensibly to save Bihar, but really to extend his influence there. The advance of Safdar Jung caused panic among the Patna populace. Sayyid Hedayat Ali Khan, deputy of Haibat Jung, waited on him at Maner. Safdar entered Patna city on 7th December, 1742 and began to rule as virtual dictator of Bihar from his camp at Bankipur. He ordered Hedayat Ali to surrender to him the Patna fort and had its gate guarded by Persian soldiers. His oppressive measures disturbed the trade of Bihar and Bengal and affected the English East India Company's commerce at Patna. However, in 1748 he retreated to Oudh; on hearing of Alivardi's return from Orissa and of the impending arrival of Peshwa Balaji Rao to Bihar to help Alivardi.

The second Maratha invasion under Raghuji Bhonsla appeared in 1748. The Emperor, unable to oppose this Maratha chief, persuaded Peshwa Balaji Rao to chastise him. Balaji marched into Bihar (February 1748) from the south with a force of 50,000 cavalry, blackmailing and harassing the people on his way. The fort of Ghauspur in the neighbourhood of Daudnagar was besieged and the town was plundered. The advance alarmed the citizens of Patna who sent their families away to Hajipur. But Balaji did not march to Patna. Passing through Tikari, Gaya, Manpur, Bihar and Monghyr, he reached Bhagalpur, where the brave widow of Sarfaraz's general, Ghaus Khan, determined to defend herself but highly impressed with her courage the Peshwa gave her protection. An old Rajput inhabitant of the Colgong hills named Sitaram Ray served as the guide of the Peshwa through the Rajmahal hills in return for a payment of one lakh of rupees. Alivardi agreed to pay Shahu the *chauth* for Bengal and 22 lakhs of rupees.

to the Peshwa, who promised to arrange matters with Raghuji Bhonsla in such a way that he would not invade Bengal in future. The two Maratha armies retired from Bengal by the end of May, 1743. In August, 1743, Shahu defined the respective spheres of influence of the Peshwa and the Bhonsla; Tikari and Bhojpur (and Daudnagar) under the Peshwa, and the rest of Bihar, together with Oudh, Bengal and Orissa under the Bhonsla. Bhaskar Pandit was killed (1744) during the third Maratha invasion of Bengal. During the fourth Maratha invasion in 1745, Raghuji, passing through the jungles of north Birbhum and the hills of Kharagpur (south Monghyr) reached Futwah, sacked and burnt it, plundered Shaikhpura and other villages in Tikari estate and marched towards Patna. But on hearing of this Alivardi marched from Murshidabad in Bihar, and fought with the Marathas near Mehaib Alipur (on the east bank of the Sone, 19 miles south west of Naubatpur). The two parties had another fighting near Bhagalpur on their way back to Murshidabad. Besides the Maratha invasion Alivardi had to face the Afghan insurrection in Bihar. The first man to make a bid for Afghan supremacy in Bihar in the 18th century was Alivardi's ambitious general, Mustafa Khan. Since he could not get the promised deputy governorship of Bihar he rebelled against the Nawab in 1745 and, marching from Murshidabad, captured the fort of Monghyr, on his way to Patna. Haibat Jung, the then deputy governor of Bihar, decided to oppose the Afghans with the help of the local nobles, including Rajas Kiratchand and Ramnarain, zamindars, including Sundar Singh of Tekari, Pahalwan Singh of Sassaram and Chainpur and Bharat Singh of Arwal. Later on Alivardi himself came and chased Mustafa out of Bihar. But the latter soon re-entered Shahabad, where the local zamindars, especially Udwant Singh Ujjaini of Jagdishpur (18 miles south-west of Arrah) were hostile to Haibat Jung. Mustafa was, however, crushingly defeated by Haibat Jung, and killed near Jagdishpur (June, 1745). The Afghans fled to Magror (14 miles west of Chainpur on the bank of Karamnasa river) and sent an appeal for help to Raghuji Bhonsla, who, as has been already noted, invaded Bihar (September, 1745).

Haibat Jung soon aspired to seize the government of Bengal and to enlist the support of the Afghans of Darbhanga, held an interview with them at Hajipur. In the ceremonial interview arranged in the *Chihil Setun*, Haibat Jung was killed by the Afghans who occupied Patna. Patna suffered untold miseries during three months of Afghan usurpation (1748).

The Afghans were supported by the Marathas who fought with the Bengal army near Bhagalpur and joined the Afghans east of Patna city. But there was some friction between the allies, and their combined forces were defeated at Ranisarai (18 miles west of Barh).

In addition to the trouble caused by the Marathas and the Afghans, Siraj-ud-daula, the nominal deputy governor of Bihar, made a dash on Patna City in



June, 1750. But it was skilfully defended by Jankiram, Alivardi's agent, who governed Bihar efficiently till his death in 1752. He was succeeded by Raja Ramnarain, who served as the *Naib Nazim* or deputy governor of Bihar till 1761 when he was deposed and imprisoned by Nawab Mir Qasim, who was responsible for his death by drowning in the Ganges at Monghyr in 1763.

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## MODERN BIHAR

The battle of Plassey in 1757 saw the establishment of the British power in Bengal and Bihar. With the British help Nawab Siraj-ud-daulah was overthrown and the British puppet Mir Jafar was placed on the *masnad* of Bengal. The leading officers and zamindars of Bihar were not prepared to accept the new change. Soon after the battle of Plassey (June, 1757), Raja Ramnarain, the Kayastha deputy governor at Patna, Kamgar Khan, the Muhammadan zamindar of Narhat Samai, Sundar Singh, the Bhumihar Raja of Tikari, Pahalwan Singh of Bhojpur and Bishun Singh of Siris-Kutumba, manifested a spirit of opposition against him and his foreign allies. To cap the climax, Jean Law, the French adventurer, came to their assistance. But the opposition against the new regime was put down by Clive who came to Patna accompanied by Mir Jafar. A few months afterwards Clive himself came to Patna accompanied by Mir Jafar, and succeeded in putting down the opposition against the new regime. In return for this valuable service, the Nawab granted to the English Company, at the close of 1757 or the beginning of 1758, the monopoly of the saltpetre trade in Bihar. This privilege was of considerable significance for the Company, since it placed at their disposal an easy supply of a highly needed material for manufacture of gunpowder. It evoked strong protests from the Dutch and eventually drove them to a desperate move in 1759.

Soon after Clive had left Patna, fresh troubles arose in Bihar, as Ali Gauhar, son of Emperor Alamgir II, invaded the province in March 1759. He besieged Patna and was joined by Jean Law. But Clive foiled the attempt, and he marched up to the Karamnasa "clearing the country of the scattered bands of plunderers". He then returned to Bengal leaving Captain Cochrane to hold charge of Patna.

On the death of his father (29th November 1759) Ali Gauhar proclaimed himself Emperor of India and invaded Bihar in 1759-60 for the second time. Kamgar Khan Mian of Narhat joined him with 5,000 men. On the 9th February, 1760, Ramnarain fought the imperialists but was defeated. With the arrival of reinforcement the English succeeded in obtaining a victory over the forces of the Emperor on the 22nd February. The Emperor then moved towards Bengal, but after

proceeding for some distance he retreated back to Patna. At Bihar Sharif Jean Law was waiting to join him, and the army now proceeded towards Patna. Patna was besieged late in April, its defence being conducted by about three hundred sepoys and three hundred cavalry. Fresh British troops soon arrived for the relief of the city, and compelled the Emperor to raise the siege and move back towards Gaya. In June, 1760, Khadam Husain, the refractory *fauzdar* of Purnea, arrived at Hajipur with the intention of joining the Emperor, but was defeated. The baffled Emperor soon left the province.

On the expiry of the rainy season, Shah Alam II invaded Bihar for the third time. But on the 15th January, 1761, the Emperor was finally defeated by Col. Carnac at Suan (a village six miles west of Bihar city) and his associate Jean Law was taken prisoner with other French officers. He came to terms with the English and was recognised as Emperor in the English factory at Gulzarbagh on the 12th March 1761. Nawab Mir Qasim also waited upon him.

But the relations between the English Company and the new Nawab soon ceased to be cordial and under Mir Qasim Bihar played an important part in the fight against the British. Mir Qasim's grievances against the Company regarding the fraudulent use of the *dastaks* by their servants generated acute differences between the two parties, which were intensified by certain highhanded measures on the part of Mr. Ellis, chief of the English Company's factory at Patna. At last the differences became irreconcilable. On the 25th May, 1763, Mir Qasim captured some boats carrying war implements to Ellis at Patna; and as a reply to that Ellis seized Patna on the 25th June. Then the Nawab's troops besieged the English at Patna. The British troops crossed the Ganges and met another party of the Nawab's forces at Manjhi at the confluence of the Ganges and the Gandak. They were beaten and captured. But the Nawab was defeated in three engagements at Suti, Giria, and Udhuanala, (all near Rajmahal). The last battle fought on the 5th September, 1763, was, according to Malleson, "one of the most daring and most successful feats of arms ever achieved". On the following day Major Adams, the victor of Udhuanala, captured Rajmahal and then marched towards Monghyr. Monghyr fell on the 1st October and four days later the English prisoners at Patna are said to have been massacred under the orders of the Nawab. Nevertheless, on the 6th November the English recovered Patna, and Mir Qasim, disheartened and without ally, escaped into the territory of the Nawab of Oudh, who gave him a cordial welcome. Mir Qasim had been formally deposed and the aged Mir Jafar reinstated on the *masnad* of Murshidabad in July, 1763.

Mir Qasim was not the man to accept humiliation and defeat so easily. He formed an alliance with the Nawab Wazir of Oudh and Emperor Shah Alam II with a view to recovering Bengal. But the allies were crushingly defeated at Buxar on the 23rd October, 1764, by the English forces under Hector Munro and were hotly chased out of Bihar.

The battle of Buxar, both as a hard-fought campaign and in its consequences, far excels Plassey in importance. In the words of Malletson, "whether regarded as a duel between the foreigner and the native, or as an event pregnant with vast permanent consequences, Buxar takes rank amongst the most decisive battles ever fought. Not only did the victory of the English save Bengal, not only did it advance the British frontier to Allahabad, but it bound the rulers of Awadh to the conqueror by ties of admiration, of gratitude, of absolute reliance and trust, ties that made them for ninety-four years that followed the friends of his friends and the enemies of his enemies". The English victory at Buxar helped the Company to get the *diwani* of Bengal, Bihar and Orissa in 1765,—a further and much more solid step in the advance of their political authority over India than any that had preceded it.

The victory at Buxar did not, however, completely crush the spirit of independence in the province of Bihar. The spirit of revolt, once awakened, continued to disturb the peace of Purnea for some time. Besides, since Bihar bordered on the territories of the Nawab Wazir of Oudh, who was constantly intriguing with the Rohillas, the Jats and Marathas, his movements had to be carefully watched by the English Company. Arrangements were made to observe and report on the movements and intentions of the Marathas and to take steps for the survey of the roads and passes in Bihar and, if necessary, to send the British forces across the Karmanasa. Further, the intentions and activities of the Afghans could by no means be overlooked. "Bihar thus formed the watch-tower of the English" during this period of turmoil in Northern India.

The grant of the *Diwani* was followed by certain administrative changes in the province. Mir Jafar had already appointed his brother, Mirza Mohammad Kazim Khan, governor of Bihar with Dhiraj Narain, brother of Raja Ramnarain, as his deputy. Since the choice was not a happy one, in 1765 Kazim Khan was pensioned off and Dhiraj Narain was allowed to carry on the government of the province with Raja Shitab Rai as *Diwan*. Later on in 1767 Shitab Rai was made the Company's *Najib Diwan* of Bihar. The same year saw the appointment of Thomas Rumbold as chief of the Patna factory. Rumbold and Shitab Rai carried on the administration of the province jointly till 1769 when the former left for England. After this departure the government was carried on by his successor James Alexander, jointly with Shitab Rai.

The system of double government established by Clive was responsible for untold miseries for the three provinces of Bengal, Bihar, and Orissa. The oppression and exploitation of the Indian tax-collectors on the ryots reached their highest point and the provinces were literally sacked dry under the abusive system of revenue collection. The appointment of European supervisors in 1769 merely "made confusion worse confounded and corruption more corrupt", while all the abuses

connected with the internal trade of the Company's servants continued. On top of it came the famine of 1770, the most dreadful calamity that had ever befallen Bengal and Bihar under the Mughals.

In 1770, Shitab Rai reported that fifty persons were dying every day in the city of Patna. The government tried some relief measures which, however, proved wholly inadequate. In April James Alexander reported that "the depopulation in the interior part of the country is more rapid than will be imagined by any person who had not witnessed it". If Patna suffered so terribly from the ravages of the calamity, the other parts of Bihar were not free from it. The districts of Bhagalpur, Purnea and Darbhanga were particularly hard hit by the famine, and harrowing accounts of their miseries are to be found in some of the Company's records of the time.

In 1770 the administration of Bihar saw a change in the form of the appointment of the Revenue Council of Patna, consisting of a president and two members. The Council supervised the revenue collection, but Shitab Rai remained in charge of the *Nizamat* administration. Complaints on the part of the ryots about the heavy exactions of the rent-collectors led the Council to fix the maximum rent at nine-sixteenths of the produce. When Warren Hastings came as governor of Bengal, in 1772, the dual government was abolished and Raja Shitab Rai was removed from his post. Shitab Rai was removed, but his son Kalyan Singh was appointed *Rayrayan* of Bihar. The general revenue administration of the province remained in the hands of the Council.

In 1781 the Revenue Council was abolished owing to its unsatisfactory administration and the whole of Bihar was farmed out to the Rayrayan Kalyan Singh who managed it with his *naib*. He failed to realise the revenues which fell in large arrears. The experiment was accordingly abandoned in 1783, and a new settlement was made.

Meanwhile in August, 1781, Bihar had once again become a centre of opposition, against the English. The news of Chait Singh's revolt produced an alarm in Patna, which was checked through the tact and fortitude of Mr. Hastings. But in the neighbourhood of the city there was a conspiracy on behalf of Chait Singh. Narain Singh, the zamindar of Siris-Kutumba, and Iqbal Ali Khan, son of Kamgar Khan, actively supported his cause. They raised troops for the purpose and began to plunder the country round Patna. But their opposition was soon put down, and Iqbal Ali's estates were seized and granted to one Ali Ibrahim Khan who was friendly to the English.

In 1783 John Shore came to Patna and made a settlement of revenue for a term of three years. It was a mere farming settlement "which was extended on its expiry from year to year until the Decennial Settlement". In 1783 another famine

threatened Bihar. To prevent it, the government forbade the export of grain to Tirhut and Saran and sanctioned the building of a huge granary at Bankipur.

It was from Bihar that there began a strong move for the adoption of the permanent settlement. Its champion was Thomas Law, Collector of the district of Bihar (Patna-Gaya). The Board of Revenue did not approve of his plan for permanent settlement. Nevertheless Law's Scheme received the sanction of the Court of Directors in 1792 and the decennial settlement. And it was made permanent finally in 1793.

The Company took over the criminal administration of Bihar in 1790. For the first time Patna got a magistrate whose jurisdiction did not extend beyond the city and Bankipur police circle. Since the magistrate of Bihar could not deal effectively with the evil of gang robbery round Patna from his distant station at Gaya, the jurisdiction of the magistrate of Patna was extended in 1798 to cover an area of about four hundred square miles from Futwah to Maner in the west and to Naubatpur in the south.

The period 1793-1835 saw the rampant prevalence of the crimes of gang robbery and *thuggee* in Bengal as well as in Bihar. There is a large volume of correspondence among the records of the District Judge's Court at Patna relating to the subject. There appeared in North-Eastern India the organised bands of assassins known as *Thugs* in ever-increasing numbers. Between Bykantpur and Monghyr many men of the higher class were associated with the *Thugs* and at the Barh *thana* all crimes were committed with the full cognizance of the police. Mr. Bury, officiating Magistrate of Patna in 1804, remarks: "Such is the extent to which the dreadful traffic has been pursued on the old Calcutta road especially between Monghyr and Fatwa, that I can form no estimate of the expenditure of human life to which it has given occasion." One of the most important reasons for the increase of crime during this period was the lack of sound governance. The strong measures adopted by the Company's Government at last succeeded, however, in suppressing the evil.

If the political history of Bihar after Plassey is important, the economic history of the province is no less interesting. Regular English connection with Bihar for purposes of trade had begun as early as the middle of the seventeenth century.

Bihar was noted especially for the manufacture of saltpetre an ingredient necessary for gunpowder manufacture. Attracted by this branch of trade, the Dutch also had established a factory at Patna which afterwards became also the sites of a French factory and a Danish Factory.

The English Company enjoyed the monopoly of the saltpetre trade in Bihar and allowed the Dutch and the French to have a supply of saltpetre from their

factory at Patna on specified terms. They were required under the provisions of an Act of Parliament "to deliver annually to His Majesty's Government in England" five hundred tons of saltpetre at £45 per ton in peace time. In 1783-1792 the Company's trade in saltpetre proved unprofitable, which obliged them to reduce the price of the article. But the outbreak of the Revolutionary War in Europe in 1792 increased the demand for saltpetre at the British market, and the Court of Directors wrote that it "was of the greatest importance that the orders for providing and sending home saltpetre should be fully complied with". The Bengal Government was to see to it that the foreign nations should not receive a greater quantity of the article than that to which they were entitled. On the outbreak of war between England and France the export of saltpetre on the part of individuals was prohibited. When the Charter act of 1793 partially opened the East India trade to private enterprise, the restriction against the export of saltpetre by British subjects was removed. It may be noted that between 1794 and 1810 more than £3,20,000 worth of saltpetre was exported to England from Calcutta by individuals and that the far greater quantity of the article was the produce of Bihar. After the cessation of the Napoleonic war in 1815 a considerable quantity of saltpetre was exported by British private traders to China, subject to the condition of selling it to the Chinese subjects only.

The Company had saltpetre factories at Chapra, Singhia, Fatwah and Mott, under their head factory at Patna. At these factories advances were furnished to the *pykars* or middlemen, who in their turn secured the article by issuing advances to the *Nunias*. The *pykars* frequently oppressed and exploited the *Nunias* and the mode of obtaining the saltpetre investment in Bihar remained a standing grievance with these poor manufacturers.

Besides saltpetre, Bihar specialised in eighteenth century in the manufacture of opium. In 1761 the English Company obtained a monopoly of the opium business in the province. The Dutch and the French were not altogether deprived of their right to the trade, but were henceforward required to pay a duty on it to the English Company. During (1767-69) the Dutch complained that in consequence of the sole right of opium manufacture having been lately given to one of the former employees of the English they were unable to make "fair and equitable purchases" from the opium dealers. Thereupon the Governor issued instructions for throwing open the opium trade, subject to the payment of the requisite duty to the Company. But in 1773 Warren Hastings finally declared it a government monopoly in the teeth of great opposition on the part of some of his councillors. Hastings also introduced the contract system for the provision of opium, a system which, though highly defective, continued under Cornwallis. Cornwallis introduced a number of reforms for the improved management of the opium department, and these reforms did something to free the poppy-growers from the oppression of the contractors. Finally in 1797 the contract

system was abolished, and the supply of opium was henceforward obtained through a covenanted servant of the Company styled the Opium Agent.

With the adoption of the agency system we pass into a new phase in the history of the Company's opium monopoly in Bihar. Not only did the quality of the drug improve under the new system, but the Agent was enabled to produce a larger quantity of the article than before. It may be noted that in the year 1808-09 the total production of Bihar opium nearly exceeded 8,000 maunds.

In the Company's records of the early nineteenth century there are references to the opium factories in Bihar. Under the opium factory at Patna, there were subordinate factories of Bihar, Shahabad, Saran and Tirhut. Bihar had no fewer than eight subordinate opium factories, and in Saran we have references to the existence of three such factories, while in Tirhut there were four opium factories. Most of these *kuthis* continued to exist down to the end of the last century. Early in the present century, however, Bihar ceased to be the centre of opium production, and several opium factories were closed after 1910, the buildings of the factories being utilised for other purposes.

From early times Bihar was also an important centre of cloth manufacture. In 1787 the English factory at Patna, together with its subordinate *aurungs*, was constituted a Commercial Residency for the supply of cloth investment to the Company. A Commercial Resident was stationed at Patna for the purpose, and the weavers' regulations were made applicable to the province of Bihar. In accordance with these regulations the Commercial Resident issued advance to the weavers for different varieties of fabrics. Patna was specially well-known for several species of calicoes and chintz, but some muslins were also manufactured here. The system of issuing advances to the weavers was, however, found unsuitable in Bihar, and was abandoned some time about the year 1800, and the Company's cloth investment in the province was henceforward obtained by ready money purchase in the market.

In the Board of Trade's correspondence we find reference to seven subordinate cloth factories under the commercial residency of Patna. These were situated at Jahanabad, Mogra, Miabigha, Luchnah, Shahabad, Singhia, Chapra and Bankipur. Between the head factory at Patna and these out-stations there was a close and constant contact. But they were under the immediate superintendence of Indian *gomastas*. In 1819 the Company's cloth establishments in Bihar were wound up owing to the virtual discontinuance of the export of Indian cotton piece-goods to Europe by the East India Company. Thereafter the factory buildings at Bankipur were used as part of the Government Civil Court establishments, while the guards attached to the several cloth factories were transferred to the saltpetre *kuthis*. In 1829 the Commercial Residency of Patna was abolished and the Opium Agent, Bihar, was required since then to discharge the duties of that office in addition to those of his own.

Like the English, the Dutch and the French had also set up their factories at Patna owing to its commercial importance. Whenever there was any war between England and Holland, the Dutch factory at Patna, like their possessions in other parts of India, was seized by the English Company to be returned after the cessation of hostilities. So also when England was at war with France, the French factory was captured and temporarily held by the English Company. Thus at the outbreak of war between England and France in 1793 the French factory at Patna was seized by the English. On the conclusion of the Treaty of Amiens in 1802 it was restored to the French only to be recaptured on the resumption of hostilities. It was finally restored in 1816 on the conclusion of the Napoleonic War. Similarly, when Holland was occupied by French troops in 1795, the Dutch factories in India, including the factory at Patna, were taken over by the English. Like the French factories, they were restored in 1802 and reoccupied on the resumption of the war. They were finally restored on the termination of the war. Finally, by a treaty concluded between Holland and Great Britain in 1824, the Dutch factories and possessions "on the continent of India" were ceded to the English Company. Accordingly in the following year the Dutch factory at Patna was taken over by the English and Dutch connection with Bihar ceased.

The Danish factory at Patna was established the year 1775. In 1808 it was captured by the English but was restored to the Danes in 1817. Not long afterwards, the Danish possessions in India were surrendered to the English Company.

The history of the sugar and indigo industries of Bihar during this period is also interesting. We learn from contemporary records that the condition of sugar manufacture in South Bihar towards the close of the eighteenth century was not quite satisfactory. The total area under sugarcane cultivation in the district of Bihar in 1793 was only 1,200 bighas. But about this time the Commercial Resident of Patna established a factory for sugar manufacture which seems to have given some encouragement to it. Besides the Company's sugar factory at Patna, there were several other European sugar concerns in the districts of Patna, Shahabad and Tirhut. In 1789, for instance, the Dutch erected a sugar factory at Motipur in Tirhut. The Danes, too, carried on sugar manufacture at Patna where they had an extensive range of godowns for this purpose. Most of these factories had, however, to incur losses, and were either wound up in the course of a few years or converted into indigo *kuthis*. The factory at Motipur became an indigo concern under Noel and Co. in 1816. After the equalisation of the import duties on East Indian and West Indian sugar in Great Britain in 1836, Europeans were again attracted to start sugar plantations in North Bihar. Between 1836 and 1848 some factories were established by them in Tirhut and Saran. Further attempts at sugar manufacture were made by the Europeans in the second half of the nineteenth century. Some of these concerns continued to flourish



until recently. A few of them like the Marhaura Sugar Factory in Saran district still exist. But in most of them the experiments at sugar manufacture have been abandoned. The European planters have also disposed of their factories in North Bihar and left India.

European enterprise in Bihar achieved a much larger measure of success in indigo than in sugar. Indigo manufacture in this province received much encouragement from Mr. Francois Grand, the first Collector of Tirhut. Between 1782 and 1785 he created three indigo *kuthis* at his own expense in Tirhut. By 1803, however, the number of indigo factories in the district swelled to about twenty-five. In Purnea there were at the time of Buchanan's survey more than seventy-five indigo factories under European management, besides seven others belonging to two Hindu zamindars and a "native Portuguese". But in the district of Bihar indigo manufacture was relatively unimportant, the total number of factories there in the time of Buchanan being not more than seven. In Shahabad there were then eighteen factories with 17,000 bighas of land under cultivation. In Bhagalpur, too, there were many indigo factories at this time. The total number of indigo factories in Bihar, according to an estimate of 1830, was 191, and these were owned by 32 European planters. Indigo manufacture continued to flourish in the province down to the close of the last century. The invention of the synthetic dye in Germany killed the demand for Indian indigo in foreign markets, and most of the factories were accordingly abandoned by the opening of the present century. The Great War of 1914-18, however, led to the revival of the demand on a limited scale, and an attempt was then made in some parts of North Bihar to begin the cultivation of indigo anew. But the experiment did not last long.

The relation between the European planters and the indigo ryots in Bihar, though not so unsatisfactory as in the neighbouring province of Bengal, was by no means cordial. Advances for indigo had often to be forced on the cultivators, and resort to violence on the part of the planters in connection with it was pretty common. Even so late as 1920 the planters' treatment towards the indigo-growers in Champaran formed a subject of bitter comment and added to the intensity of the Non-co-operation Movement in the province.

There were two uprisings which are specially worthy of note. One was the Santal Insurrection of 1855-57, and the other was the Sepoy Mutiny of 1857-59. The first was a movement of the Santals and it originated as a protest against the long existing frauds and deception to which they were subject in the hands of non-Santal businessmen. Bands of Santals marched behind chosen leaders in several directions, plundering and slaying the peaceful inhabitants, including many Europeans. The insurrection soon took the character of an anti-government movement, and for a year the jungle tracts of Santal Parganas and the adjoining districts of Bhagalpur and Birbhum remained in a state of perpetual alarm on account of it. The Government of Bengal sent detachments of troops from

Calcutta and Dinapur to deal with the situation. And after the suppression of the insurrection, they thought it advisable to create a new district known as Santal Parganas with special laws and regulations.

More formidable than the Santal revolt was the Mutiny that followed two years later. The outbreak of the Mutiny in other parts of Northern India was a signal for a similar rising at Patna. A rising of some Muhammadans in Patna early in July, 1857, was followed by a mutiny among the sepoys of Dinapur. On the approach of the European troops they fled, but the main body of the mutineers crossed the Sone to join Kunwar Singh of Arrah, who had raised the standard of revolt against the Company's Government.

At Arrah the rising proved all the more alarming. There Kunwar Singh, had been discontented on account of the revenue system which had greatly reduced his means. The revolt of the sepoys at Dinapur made him determined to support them. On the 27th July intelligence reached Patna that the sepoys had besieged Arrah. Immediately 193 men were sent for the relief of the city. Unfortunately the steamer carrying these men got stuck in the sand. Disheartened and outwitted, they retreated. Half of their numbers were left behind and of those that returned only 50 were injured. Two hundred British soldiers were then sent by Mr. Taylor, Commissioner of Patna, to overawe the mutineers at Arrah, and on their approach most of the mutineers dispersed. For the rest of the year stray bands of mutineers roamed over the district plundering and pillaging; and complete order was not restored before the beginning of 1858.

From Patna and Arrah the mutiny spread to Gaya and Muzaffarpur. The Collector of Gaya was outwitted on August 4 by the Indian station guards who released the prisoners at the local jail. And at Muzaffarpur an attempt was made by the mutineers on the public treasury. But the attack was repelled by the police who received adequate help from the wealthy bankers and merchants of the city. The man who finally restored order in the province was one Major Eyre. As Malleson points out, he "virtually reconquered Bihar". Mr. Taylor also rendered valuable services to the government in this respect. But the latter was dismissed from his post because he had adopted some "measures not altogether approved of by the Lieutenant Governor".

In the second half of the 19th century, Bihar was visited by severe famines, thrice in 1866, 1874, and 1879. Other areas of the province had to suffer, but the district of Patna escaped the severities. This was due partly to the facility of transportation established by the opening of the railways. The most severe of the three famines was that of 1897 caused by deficient rainfall in the preceding year. Hundreds of starved wanderers passed on this occasion along the highway between the United Provinces and Bengal, begging for relief, and provision was made for them at kitchens and poor-houses.

After the Permanent Settlement important changes were introduced in the administrative machinery of the province. We have already seen that the jurisdiction of the magistracy of Patna was extended in 1798. In 1825 was created a new district of Patna, consisting of the district as it is at the present day without the *parganas* of Bihar (Bihar Sharif) and Rajgir. But in 1865 these were transferred to Patna from the Bihar District, which became known as the District of Gaya. In 1866 the District of Saran was divided into two, one part retaining the name Saran, while the other became known as Champaran. Likewise in 1875 Tirhut was divided into two districts, Muzaffarpur and Darbhanga. Bihar continued to form part of the Bengal Presidency until 1911-12. Local patriotism and consciousness led to a strong agitation for a separate province of Bihar. On the 12th December, 1911, however, the King-Emperor at Delhi announced the creation of the new province of Bihar and Orissa with Patna as its capital. The province came into being in 1912; but it still remained under the High Court of Calcutta for judicial purposes and under the Calcutta University for educational purposes. In 1916 the province came to have its own High Court at Patna, and in the following year was drawn up the constitution of a University in the capital city. The Patna University was made an affiliating and examining body with jurisdiction over Bihar and Orissa.

# ARCHAEOLOGY OF BIHAR

(From the earliest times to A. D. 1200)

*By*

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Situated in the heart of the Gangetic valley, Bihar offers an extensive and varied scope for archaeological research. While the Himalayas and the jungly tracts of Chota Nagpur ensured for it in early times an isolation from the north and south resulting in a limited possibility of culture-percolation, the absence of any well-defined natural boundary on the west and the scanty obstruction afforded by the Rajmahal Hills on the east, together with the great unifying agency of the Ganges and her tributaries, have, throughout the history of the province, given ample chance of the influx and outflow of cultural elements. Bihar has been the seat of large empires extending far beyond its initial limits; it has, on the other hand formed integral parts of empires with their seats situated far away. The forces of inter-provincial contacts have acted and re-acted on its culture and consequently on its archaeology. It is difficult, therefore, in most cases to single out any group of its varied archaeological remains and monuments as a typical product of the soil. In fact, its archaeology is only a chapter of the archaeology of India, but not one lacking in importance and individual features.

## A. THE PREHISTORIC PERIOD

*The Palaeolithic Age:*—The history of human endeavour in Bihar goes back to the very earliest times. Old Stone Age artifacts have been picked up from various places in Chota Nagpur which indicate that the plateau was inhabited by the palaeolithic man. In 1865 a handaxe of green micaceous quartzite was picked up by Hughes near the coal-fields on the Bokaro, a tributary of the Damodar in Hazaribagh District. In the same year V. Ball found at Kunkune near Govindapur in Manbhum district a similar palaeolith of the same material. Two years later another implement was found at Gopinathpur in the same District. All these were found in 'apparent association with the taluses of pebbles from the Gondwana rocks of this region'.<sup>1</sup>

In 1915 C. W. Anderson found in his exploration of the banks of the Sanjai and Binjai near Chakradharpore, District Singhbhum, some handaxes in the gravel-bed underlying a reddish clay-deposit.<sup>2</sup> The stratification, as recorded, lacks clarity but may yield important results after re-examination.

All these implements belong to the Acheulean type of core-industry reminiscent of the Madras industry, but the geological stratification of their findspots is vague and should be subjected to trained and intensive investigation. Till that is done and a geological and typological co-ordination is established between the Chota Nagpur and the Madras industries, in which the palaeoliths of the hill-tracts of the Orissa States may provide an important link, these finds will remain isolated and of uncertain date. In the meantime a guess may be hazarded that Chota Nagpur marks the northernmost outpost of the diffusion of an extensive palaeolithic industry, of which the Kortalar valley in Chingleput District (Madras Presidency) was the southernmost and probably the most prolific station.

*Microolithic sites* :—Microliths or 'pygmy' flakes, essentially a flake-industry, extensively found in the Vindhyan plateau and the Deccan, still occupy an undefined place in the Indian Stone Age sequence.<sup>3</sup> In Bihar microliths of chert were collected from the river-bank from Chakradharpur to Chaibasa, District Singhbhum, by Beeching in 1868, and from undefined places in Ranchi District by W. H. P. Driver in 1887.<sup>4</sup> C. W. Anderson and M. Ghosh in their explorations near Chakradharpore and E. F. O. Murray in his exploration in Dhalbhum also recovered microliths from various places. The microliths from all over India form a monotonous series of blades, burins, crescents, triangles and cones, of triangular, trapezoid or rhomboid section and the Bihar ones are not distinguished by any differentiae.

*The Neolithic Age* :—Neolithic celts have been recovered from the Districts of Ranchi, Singhbhum, Manbhum, Hazaribagh and Santal Parganas and from Ghora Katora near Rajgir (District Patna).<sup>5</sup> It should also be noted that one celt was found in a historical level of Rajgir and two in the Nalanda excavations.

A large number of household objects from Chota Nagpur, as from elsewhere in India, have been ascribed to the Neolithic Age, but it should be borne in mind that household stone objects continued to be in extensive use in India in the later periods as well, as they are even now; for this reason, not all objects of this category need necessarily be actually neolithic, unless they are proved to be so on other grounds.

*The Copper Age* :—It is necessary to apply the same caution to the Copper Antiquities, all of which cannot be ascribed to the Copper Age. For this reason it is safe to discount some finds from Ranchi District, though there are some other undoubtedly Copper Age specimens.<sup>6</sup> A hoard of five pieces of smelted copper, three of which were unfinished shouldered celts, was found near Karharbari in Pachamba Sub-division, Hazaribagh District.<sup>7</sup> There is an unillustrated record of the discovery of twenty-seven copper axe-heads from various places in Manbhum District. Besides there are specimens from Palamau and Santal Parganas in the Patna Museum.

It is of interest to note that there are extensive traces of ancient workings in copper in the copper-belt in Singhbhum. Such traces are found between the villages Keruyadungri and Rangadih, between Talsa and Nandup and on Chandar Buru, all near the border of Saraikela State and Dhalbhum Sub-division, where, more than one copper vein had been tapped by the ancients.<sup>9</sup> Old circular ventilation-shafts, 3 to 4 feet in diameter, are found, along with considerable dump and slag. Evidence of mining continues eastwards to the Rakha Hills. There is no clue to the date of these workings, but from the fact that at some of these places there is plenty of iron-ore anciently untouched, it may be inferred that at least some of the workings date back to the pre-Iron Age.

*The Asura Sites in Ranchi District*<sup>10</sup>.—The first scholar to draw the attention of the archaeological world to some ancient sites in Ranchi District was Sarat Chandra Roy, who, during 1915 and 1926, published accounts of some ruined habitation-sites and ancient burial-grounds, mostly situated in Khunti Sub-division.<sup>11</sup> The habitation-sites are marked on the surface by a considerable amount of brick-bats, potsherds and occasionally other finds, and the burial-grounds by large slabs of stone laid horizontally and resting on four small stones, below which are placed one or more burial-jars containing pieces of bone, carbonized or otherwise, copper ornaments, stone beads, etc. From exterior appearance there is little to distinguish the ancient burial-grounds from the ones still in use, for the funeral custom of the Mundas, the native aboriginals of the place, still requires the use of burial-urns to contain the bones left after cremation and slabs of stone to bury them.<sup>12</sup>

The habitation-sites present an unsolved mystery, as they cannot be ascribed to the ancestors of the present inhabitants of the locality, who do not even now know the use of bricks. Whatever the antiquity of the sites, they represent a culture-phase distinctly non-Munda in character. According to Roy, these remains, as also the ancient graveyards, ruins of temples, architectural fragments etc., are invariably ascribed by the local people to the Asuras, who are believed to have been the pre-Munda inhabitants of the land. The tradition, as recorded, contains a considerable confusion between the Asuras (demons of Hindu mythology) and the Asur tribe, a branch of the Agarias, the blacksmiths and iron-smelters of the Central Provinces and Chota Nagpur. So seriously has been the Asura tradition believed in that whatever is ancient and non-Munda in the Munda land—neolithic artifacts, copper and iron objects and ruined temples—has been attributed to a single people, the Asuras.

In 1944 the writer undertook an exploration of the southern part of Ranchi District, which is particularly full of such sites. The habitation-sites were found to vary in extent but were all alike in surface-indications, leaving little doubt about their contemporaneity. One of them, at Kunjla, 2½ miles south-south-west

of Khunti, was completely excavated, and the shell of an isolated but compact house, 63 feet long and 20 feet wide, was revealed (Plate I). The proceeds of the excavation were unvaried and not many in number, and mostly consisted of iron objects. The pottery was thick and of coarse texture, being made of badly-levigated clay with small bits of quartz, and was indifferently baked. Potsherds with these characteristics were found on the surface of all habitation-sites and many burial-sites, indicating a common authorship.

The short operation was not extensive enough to establish the date of the sites but was sufficient to establish that they belonged to a full-fledged Iron Age and that there was no Stone Age or Copper Age culture associated with them. Such neoliths and copper objects as have been found in Ranchi District are stray finds unconnected with any of these sites.

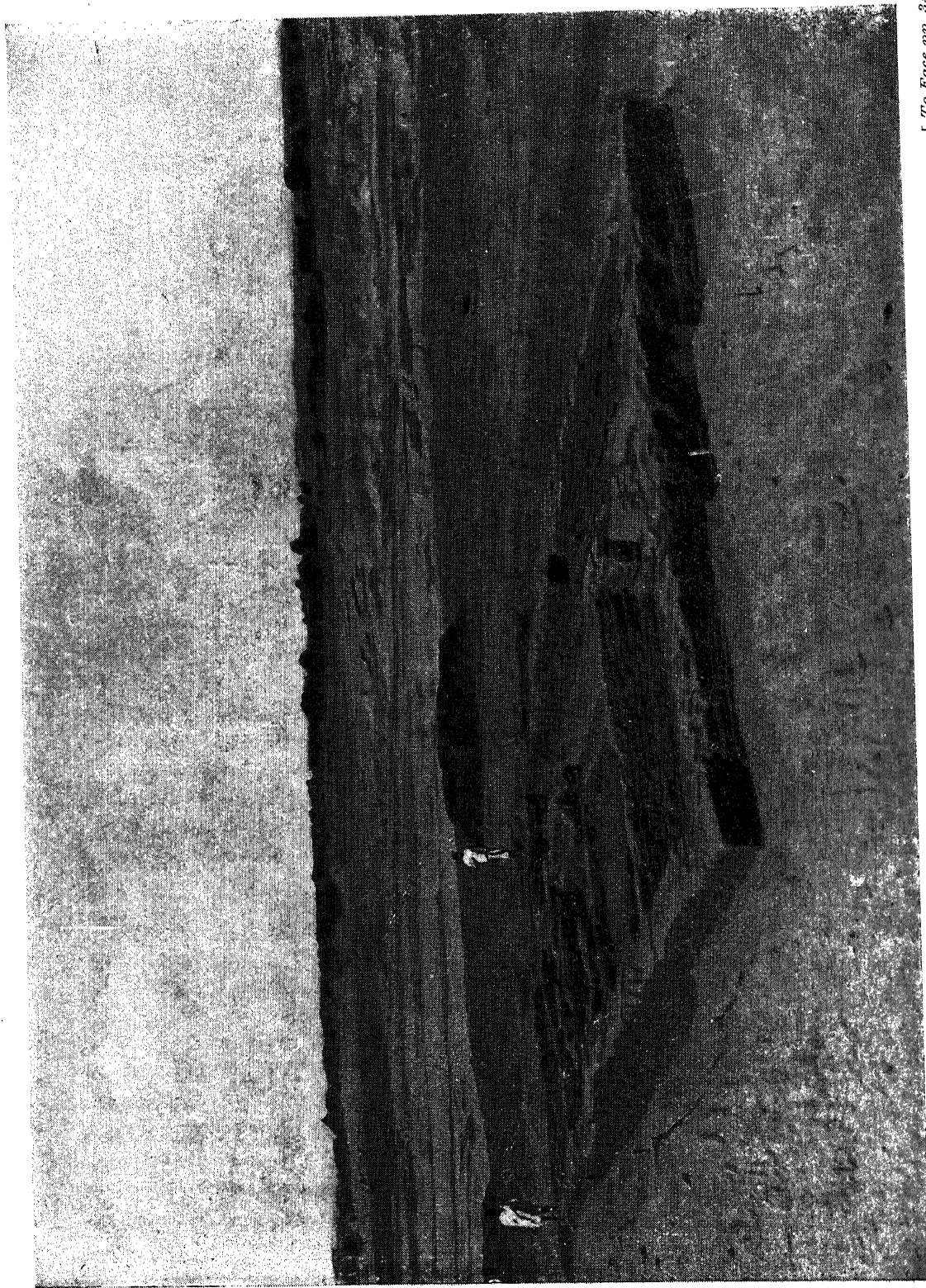
An accurate knowledge of the ethnic inroads into this primitive land may be of help in the solution of the problem, but nothing reliable is known in this direction, not even if the Mundas are autochthons in this region.

## B. THE PRE-MAURYAN AGE

Like the rest of India Bihar offers little material to bridge the great gulf between the prehistoric and historical periods. Most of the attempts to find the missing link are based on inconclusive data and fail to carry conviction. Bihar contains some relics, however, which, though older than the Maurya period, from which Indian archaeology can be traced onwards with fair consistency, do not present a picture of detachment and isolation from the historical period as do the relics and their respective cultures described above. Rajgir is the only place which is known to contain such relics, though it is not unlikely that there may be others not yet explored.

*Rajgir*.—Rajgir (ancient Rajagriha, Girivraja or Kusagrapura), situated in the south-eastern corner of Patna District, is known from literature to have been the capital of Magadha (South Bihar) from beyond the times of the *Mahabharata*. Situated in a valley enclosed on all sides by hills, with few narrow passes in between, it was eminently suitable for an ancient capital. Jarasandha and his son Brihadratha are said to have been its rulers during the days of the events of the *Mahabharata*, and some places are even now traditionally associated with the former. Leaving them aside, we should mention the rubble-masonry wall regarded, before the discovery of the Indus valley sites, as the earliest remains in India. It is about 25 miles in circuit, running at the top of all the surrounding hills, is 16 to 20 feet in thickness and has the greatest extant height of 12 feet; it is built of large blocks of stone laid without mortar and is provided with rectangular bastions at irregular intervals and with at least three gate-openings.

Plate 1.



"Açura" site at Kunjla, District Ranchi



The reason for ascribing this wall to a pre-Mauryan period is that Ajatasatru (491-459 B. C.), a junior contemporary of Buddha, is known to have shifted his capital from the valley to a fortified area outside. There is little doubt therefore, that the capital-site within the valley was older than his times.

Within the area encompassed by the city-wall there are other defensive walls, one of which encloses the citadel. This line of inner fortification is not exposed, but its position is marked by a ridge, 3 feet to 15 feet high. It is roughly pentagonal in shape and  $4\frac{1}{2}$  miles in perimeter, and is provided with at least four gate-openings.

As stated above, Ajatasatru built himself a new capital outside the valley. This New Rajagriha was situated to the north of the valley; to judge from the remains, it was surrounded by a wall, partly of stone and partly of mud, 3 miles in circuit. The south-western portion of the fortified area was fenced off with a stone wall 15 feet thick to form a quadrilateral citadel.

The Pali Buddhist texts and the itineraries of the Chinese pilgrims mention many buildings in Rajgir associated with Buddha and his times, the chief of which are the Gridhrakuta Hill, the monastery in the mango-grove of Jivaka, the contemporary court-physician, the monastery of Maddakuchchhi, the jail where Ajatasatru imprisoned his royal father Bimbisar, the Saptaparni Hill where the first Buddhist council was held six months after the death of Buddha, the monastery in Venuvana, the Kalanda tank and the stupa built by Ajatasatru, the last three situated outside the valley. The sites of all these have been identified with a fair certainty, but only a thorough exploration can show how much of pre-Mauryan material they contain.<sup>13</sup>

Under Udayin (459-443 B. C.), the successor of Ajatasatru, the capital of Magadha was shifted from Rajagriha to Pataliputra (modern Patna), the foundation of which was laid by Ajatasatru himself for defensive purposes. It was situated on the confluence of four rivers, the the Ganges, the Son (which has now shifted westwards), the Gandak and the Punpun, and occupied a more central position than Rajgir.

### C. THE MAURYAN AGE

*Pataliputra*.—Under the Mauryas (325-188 B. C.) Pataliputra was the headquarters of an extensive empire. Megasthenes, a Greek envoy, who spent a few years in the court of Chandragupta, the first Maurya emperor, says that the city, 9 miles long and  $1\frac{1}{2}$  miles wide, was surrounded by a wooden palisade, pierced with loop-holes for the discharge of arrows, flanked by a ditch for defence and sewerage, and surmounted by five hundred and seventy towers and sixty-four gates.

The spade of the archaeologist has been tried in many places at Patna and its suburbs. But as the modern city (including Bankipur) has been to a large extent built over the ancient site, systematic exploration is not possible. However, during 1892 to 1899 L. A. Waddell carried out some excavation at Kumrahar, a locality immediately to the south of Patna; though some of his conclusions were incorrect, he disproved the older theory that 'Pataliputra had been cut away by the Ganges'.<sup>14</sup>

In 1912 D. B. Spooner of the Archaeological Survey of India re-excavated Kumrahar, initially with funds provided by Sir Ratan Tata.<sup>15</sup> All over the main site of excavation he found ruined brick walls, which he ascribed to the Gupta period or the eighth century A. D. Below there was a layer of charcoal and black ashes, about 1 foot thick, strewn among which were innumerable fragments of polished sandstone pillars, occurring at a distance of 15 feet from each other. As at least eight rows, with ten heaps in each, of such fragment were found (see plan), it was surmised that there had existed here a Mauryan pillared hall, resting on eighty (or more) pillars which had in turn been placed on wooden support. The belt of ashes indicated that before the date of the superimposed brick structures the wooden superstructure of the building had been destroyed by fire, which was also responsible for the rending asunder of the exposed parts of the pillars.

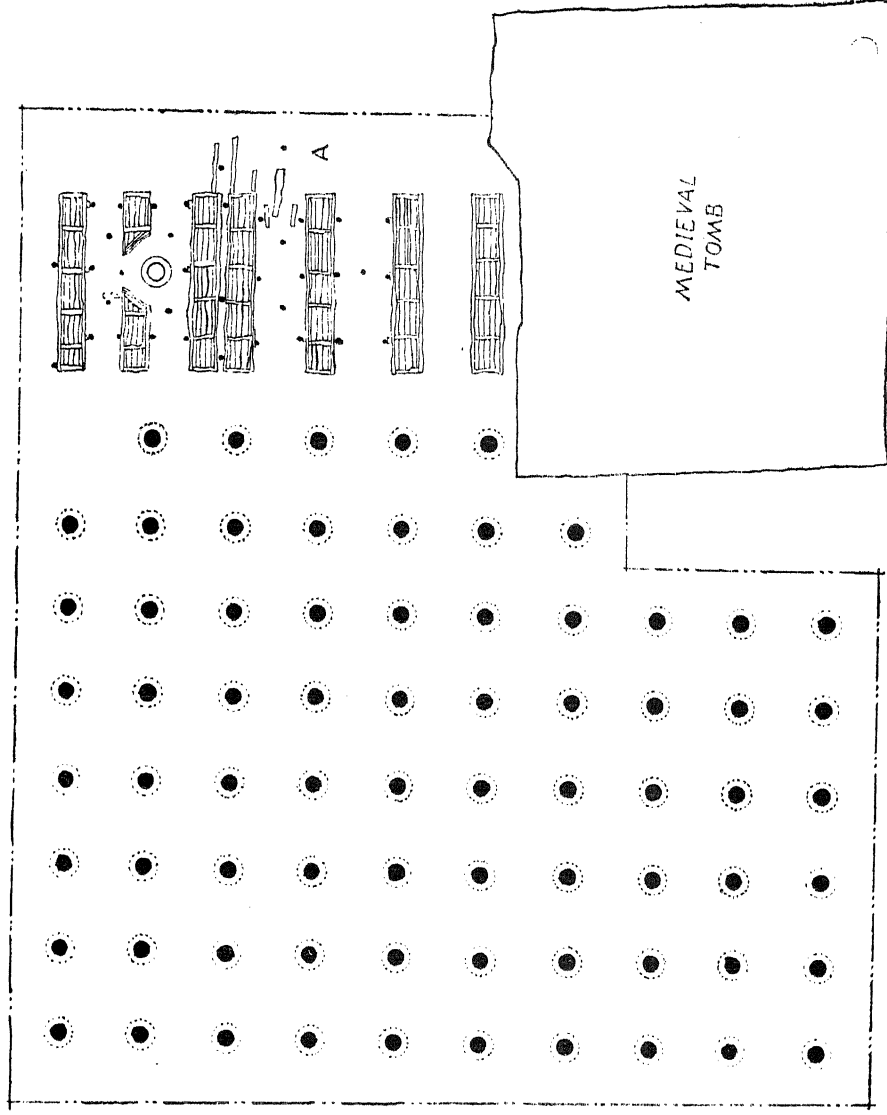
The main problem to interest Spooner was the eighty or more columns and what had happened to them. He found that below each of the places where there was an accumulation of pillar-fragments there was a tubular hole filled with ashes and pieces of stone. He argued that, as it was extremely difficult for human agency to pluck the heavy pillars without disturbing the surroundings, it was more likely that after the decay of the wooden platforms on which they rested, the pillars began to descend downwards; being of fixed weight there was no increase in the lateral friction to check their downward progress. At one place he bored the soil up to a depth of 100 feet and found that the soil was not hard enough to check the descending pillars.

In the following years Spooner carried out some more digging at Kumrahar and at Bulandibagh, about a furlong to the west of the former. As the postulated pillared hall at Kumrahar could not be compared with any other structure of India, Spooner turned to Persia for analogies and found its prototype in the Achaemenian hall at Persepolis brought to light by Herzfeld. Though there was not much in the excavation at Kumrahar to judge from what the Mauryan hall had been like, Spooner tried to establish an exact parallelism between the Persepolis and Pataliputra structures and to explain whatever he found in that light.

In 1926-27 some more work was done at Bulandibagh by J. A. Page and

# KUMRĀHĀR, PĀTALIPUTRA

SCALE OF FEET



● POSITION of PILLARS  
A. WOODEN PLATFORMS

A.S.L.

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M. Ghosh, resulting in the discovery of a wooden structure running east-west, as excavated, for a distance of 450 feet.<sup>16</sup> It took the form of a wooden wall made of heavy wooden sleepers, placed vertically in a double row, with similar sleepers joining them horizontally at the bottom. It is likely that the structure was a part of the wooden palisade mentioned by Megasthenes. At Gosain-khanda, half-a-mile to the east of Bulandibagh, a similar structure was accidentally found in 1935, but in a reversed order, viz. vertical sleepers capped by horizontal ones.<sup>17</sup>

The finds from Kumrahar and Bulandibagh consist of a variety of objects, including punch-marked coins, terracotta figurines, stone and glass beads, finished and unfinished seals, including a glass seal with a Mauryan inscription, pottery and a wooden cart-wheel, ranging in date from the Maurya to Gupta periods. The terracotta figurines are particularly important and should form the subject of an intensive study.

Various schemes of sewerage in Patna in the second decade of the present century necessitated deep diggings and resulted in the discovery of an enormous number of terracotta figurines, pottery, beads, etc. The very nature of the digs precluded the possibility of any proper record of the finds, and the proceeds, now in the Patna Museum, consist of an undifferentiated mass, intrinsically very valuable but of little chronological significance. The terracottas have been relegated on stylistic ground to the Maurya, Sunga, Kushan and, rarely, Gupta periods, and prove in bulk the great subsoil potentialities of Patna.

Of the isolated Mauryan finds from Patna, the most important is a statue found at Didarganj, 6 miles to the east of the city, and now in the Patna Museum. It is of sandstone with a polish characteristic of the pillars of Asoka and represents a life-size female figure with the raised right hand holding a *chauri* (Plate II). The female features conventional in Indian literature and sculpture, viz. a prominent bust, a narrow waist and wide hips, are already present in the statue. Altogether it is one of the most remarkable sculptures as yet found in India.

Of the other sculptures with 'Mauryan' polish, mention should be made of two naked male figures found at Lohanipur (Patna), rather heavily executed and identified as Jaina Tirthankaras, and a lion-head from Masar (District Shahabad), all in the Patna Museum. A male figure, above 6 feet in height, crudely executed in unpolished sandstone, is ascribed to c. 300 B.C. (but may be somewhat later) and is usually identified as a *yaksha*. It was found in Patna and is now in the Indian Museum.

*Monuments of Asoka*.—The reign of Asoka (273 to 232 B.C.) marks a landmark in the history of Indian architecture, and Bihar, being the nucleus of his extensive empire, had its full share of the building activities of the period. It is stated in

the Buddhist texts that Asoka rent open the eight original stupas of Buddha and distributed the relics among eighty-four thousand stupas all over India. The number is conventional but may be taken as indicating that the stupas built by him were large in number. Fa Hien and Hiuen Tsang, the Chinese pilgrims respectively of the fifth and seventh centuries A.D., ascribe to him a large number of stupas in Bihar. All of them may not belong to him, but it may be conjectured that at least those standing near his pillars were really erected by him. Thus, the stupa at Kolhua (near Basarh, District Muzaffarpur) beside an uninscribed pillar and the one at Rajgir, near which Hiuen Tsang saw a now non-existent pillar with an elephant-capital, may be Asokan. On the same grounds, one or more of the twenty stupas at Lauriya-Nandangarh (see below) may belong to him, though some of them are later.

Bihar has five pillars of Asoka, three of which are inscribed, all in the northern part of the province. It has been surmised that they stood beside the ancient highway leading from Patna to Nepal. All of them are polished monolithic shafts of Chunar sandstone, gracefully tapering towards the top. The measurements of one of the pillars at Rampurwa (Champaran District), which had been lying buried in an oblique position, was raised in 1907 and laid on a platform in 1912, may be regarded as typical: the shaft, excluding the chased portion at the top, measures 44 feet 10 inches, of which the upper portion, measuring 36 feet, is polished and was therefore intended to remain overground. The diameter is 4 feet 1 inch at the bottom and 3 feet at the top. The chase at the top,  $2\frac{1}{2}$  inches high, was intended to receive the capital which was fixed to the body of the pillar by a copper dowel, which has also been recovered. The capital, 7 feet in height, consists of the so-called bell or inverted lotus superimposed by a lion sitting on its hind legs upon a circular abacus decorated with a row of geese; at the centre of the shaft occurs a long inscription embodying six edicts of Asoka.

Close by was found, in 1907-8, the fragments of another, but uninscribed, pillar, once surmounted by a capital consisting of a magnificently carved bull, 4 feet high, standing on a circular abacus with honey-suckle design, which in turn rests upon the usual 'bell'-capital. This masterpiece, together with the lion-capital of the first pillar, is now housed in the Indian Museum.

The other inscribed pillars of Asoka are situated in two villages in the same District, both known as Lauriya, but distinguished from each other by the addition of the name of a neighbouring locality and thus now known as Lauriya-Nandangarh and Lauriya-Araraj. The pillar at the former place, 14 miles north of Bettiah, has the same inscription and same design of lion-capital as the first Rampurwa pillar. The pillar at Lauriya-Araraj, 16 miles west of Motihari, has lost its capital. The inscription is again the same.

Plate II.



Didarganj Stone Statue

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The fourth pillar, which is uninscribed, is situated at Kolhua,  $1\frac{1}{2}$  miles north-west of Basarh (see below). The capital, from bottom upwards, consists of bead-and-reel ornament, a cable-design, the 'bell'-capital, again a cable design, a plain rectangular abacus and a lion, the workmanship of which does not compare favourably with that of the Lauriya-Nandangarh and Rampurwa ones.

Mention may be made here of a polished bull-capital from Hajipur (District Muzaffarpur) now in the Patna Museum, though its association with Asoka is uncertain. It consists of a rectangular block with a palm-design both on the front and back in low relief and four crouching bulls.

Bihar contains the only caves known to have been excavated by Asoka. In the Barabar Hills, 15 miles north of Gaya, he excavated four caves, two of which are definitely known from his inscriptions to have been dedicated by him to the Ajivikas. The caves are excavated in the hardest granite, yet their interior is exquisitely polished like glass. Two of them are double-chambered, the outer chamber in each being rectangular and the inner one circular in one case and oval in the other. The vaulted roofs spring from vertical walls 6 to 7 feet high. The door is carved in the shape of an ogee arch projecting above the door-jambs, the pediment being decorated by a frieze of elephants and a diaper-pattern.

Of a later date than the above is a group of three caves in the Nagarjuni Hills, 1 mile to the north-east of Barabar. These caves were excavated and dedicated to the Ajivikas by Dasaratha, the grandson of Asoka. They consist of one chamber each, rectangular in plan, except one, which is elliptical. The roofs are vaulted, and in one case the vault springs from the floor itself. The jambs of the plain doors are as usual sloping.

## D. THE POST-MAURYAN PERIOD

*Bodh-gaya*:—The stone railing at Bodh-gaya, unlike its counterparts at Bharhut and Sanchi in Central India, does not surround a stupa but the circumambulation-path round the temple and the 'diamond-throne'. The present temple at Bodh-gaya is of a much later date (see below), but there is little doubt about the prior existence of an older temple here, as the Bodhi shrine is represented in the sculptures of Sanchi, Bharhut and Mathura; but the representations differ from each other in detail and fail to give an idea of the original.

As the railing stands at present, it consists of two distinct parts, distinguished from each other by a difference not only in material, the earlier part being made of sandstone and the later of coarse granite, but in the style of carving, which indicates a Gupta dating for the granite portion. The date of the earlier part is indicated as late second century or first century B. C. by the inscriptions on them.

The design of the railing follows the usual pattern (Plate III); it consists of square or octagonal uprights, their front and back faces carved with figures, representations of stories or lotus-medallions, and three lenticular mortises pierced at their sides to receive the cross-bars, joining the uprights and themselves containing medallions with lotuses or other objects at the centre. The uprights are surmounted by coping stones carved with continuous bands of lotuses on the outer face and animal-figures on the inner.

The low-relief carvings on the uprights show a variety of subjects, ranging from the usual lotuses to animals, life-stories of Buddha (Buddha himself, in conformity with the contemporary practice, is never represented in person), scenes from the Jatakas and the representation of the zodiac. The last group includes a remarkable figure of the sun-god on a chariot drawn by four horses, which may be regarded as the earliest representation of the god.

The sandstone slab on the 'diamond-throne' below the Bodhi tree, whether it is *in situ* or not, should be also ascribed to this period.

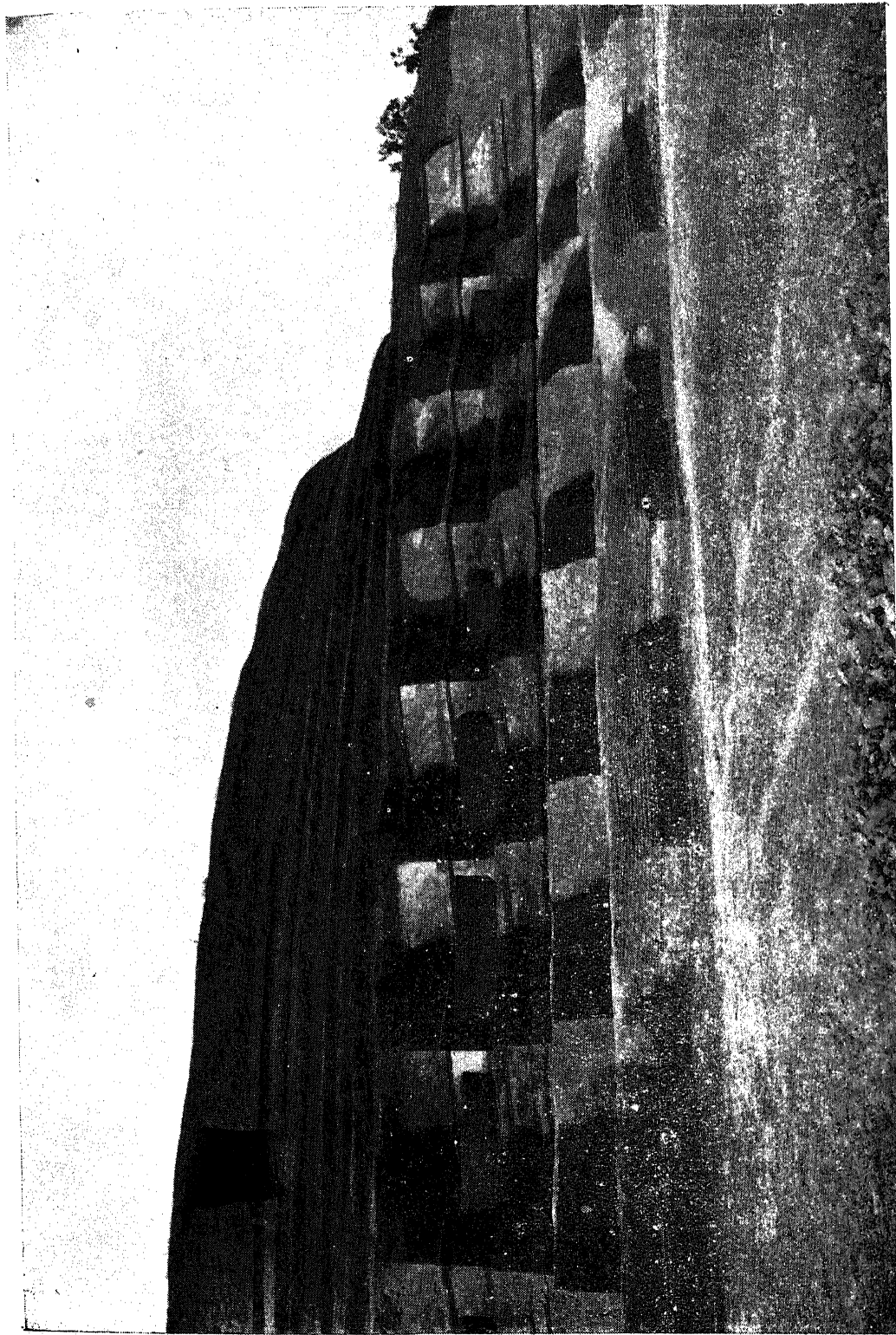
*Rajgir*:—Less than a mile from the north gate leading into the valley of Old Rajagriha stands a cylindrical brick structure, locally known as Maniyar Math. Excavation in 1905-6 and 1935-7 revealed below the level of the brick structure earlier stone walls of indeterminate date but in no way connected with the former. The brick structure was itself of several periods; connected with an early phase of it were low rectangular or round altars or platforms all over the area. On and near one such altar were found scattered a large number of multi-spouted pottery-jars of different sizes, some of the spouts being shaped like serpent hoods. Though there is no ancient parallel to these finds, it is interesting to note that similar jars are still now used in Bengal in the worship of the serpent-goddess Manasa.

The other finds in the area comprise terracotta serpent-hoods and serpent-loops and a fragmentary red sandstone sculpture carved on both sides with panels showing male and female figures with serpent-hoods.<sup>18</sup> Below one of them is an inscription containing the name *Mani-naga*. The date of the sculpture, as indicated by the inscriptions and the style of the carving, is the second century A. D. All these finds point to the conclusion that the place was the centre of serpent-cult in the early centuries of the Christian era. And as the *Mahabharata* mentions Rajagriha as the sacred abode of Mani-naga, there is little doubt that the site marks the spot where the temple of Mani-naga once stood.

Occupation in New Rajagriha continued during this period. In the slight and inconclusive excavation of 1905-6 were recovered from this area two terracotta seals of the second century B. C. and six uninscribed cast coins which are known



Plate III



Part of Nandagarh stupa after removal of later walls.

to have been current in North India in the two or three centuries preceding and following Christ.

*Lauriya-Nandangarh*.—The Asokan pillar at Lauriya-Nandangarh has been mentioned above. Lauriya also contains fifteen stupas in three rows, each row upwards of 2000 feet long; the first row begins near the Asokan pillar and runs east to west, while the other two are at right angles to it and parallel to each other. Alexander Cunningham partially excavated one of them in 1862 and found a retaining wall which he regarded as late. A few years later his assistant H. B. W. Garrick opened up several mounds with indifferent results.

In 1905 Theodore Bloch of the Archaeological Survey of India excavated four mounds, two in each of the two north-to-south rows. In two of them he found at the centre of each at a depth of 6 to 12 feet (probably meaning 6 feet in one case and 12 feet in the other) a gold leaf with a female figure standing in frontal pose and a small deposit of burnt human bones mixed with charcoal. The core of the mounds was, according to him, built of layers of yellow clay, a few inches in thickness, with grass and leaves laid in between. Further down, in one of them, he found the stump of a tree. His conclusions were that the mounds had some connexion with the funeral rites of the people who erected them, and he found an explanation of the phenomena encountered by him in the rites of cremation and post-cremation prescribed in the Vedas. On the basis of this hypothesis he indentified the gold female figure as Prithvi, the earth-goddess, and ascribed the mounds to the pre-Mauryan age. After him the mounds came to be known, rather loosely, as Vedic burial-mounds.

In 1935-6 N. G. Majumdar re-examined four mounds with important results. He found that all of them were burial memorials with a burnt-brick basement, two being faced with a brick lining in a double tier, so that there was no justification for regarding them as merely earthen barrows. He also pointed out that the gold leaves found by Bloch had their exact replica in the stupa of Piprawa (district Basti, U. P.), which is definitely Buddhist stupa of 300 B. C. or a little later. The respective Lauriya stupas might be of similar date, and there was nothing to connect them with Vedic burial rites. The layers of yellow clay with grass and leaves in between, which had a share in the building up of the Vedic theory of Bloch, were, according to the observations of the writer, nothing but ordinary mud-bricks, husks and straw being a normal ingredient of many ancient bricks.

The excavation of the Nandangarh mound was started by Majumdar in 1935 and continued by the writer till 1939. The mound, situated more than a mile to the south-west of the Asoka pillar, was, before excavation, 82 feet in height and about 1500 in circumference, standing at the eastern edge of a brick fortification about a mile in perimeter and roughly oval on plan.

Excavation of the mound revealed a stupendous terraced stupa with a polygonal basement. The walls in the four cardinal directions were each 104 feet long, and the wall between each had a zigzag course with fourteen re-entrant and thirteen outer angles. The walls flanking the first and second terraces followed the polygonal plan of the basement, but those pertaining to the upper terraces were circular. An extensive later restoration hid the four upper walls and provided new circular walls, but the polygonal plan of the walls of the basement and the first terrace remained unaltered (plate IV).

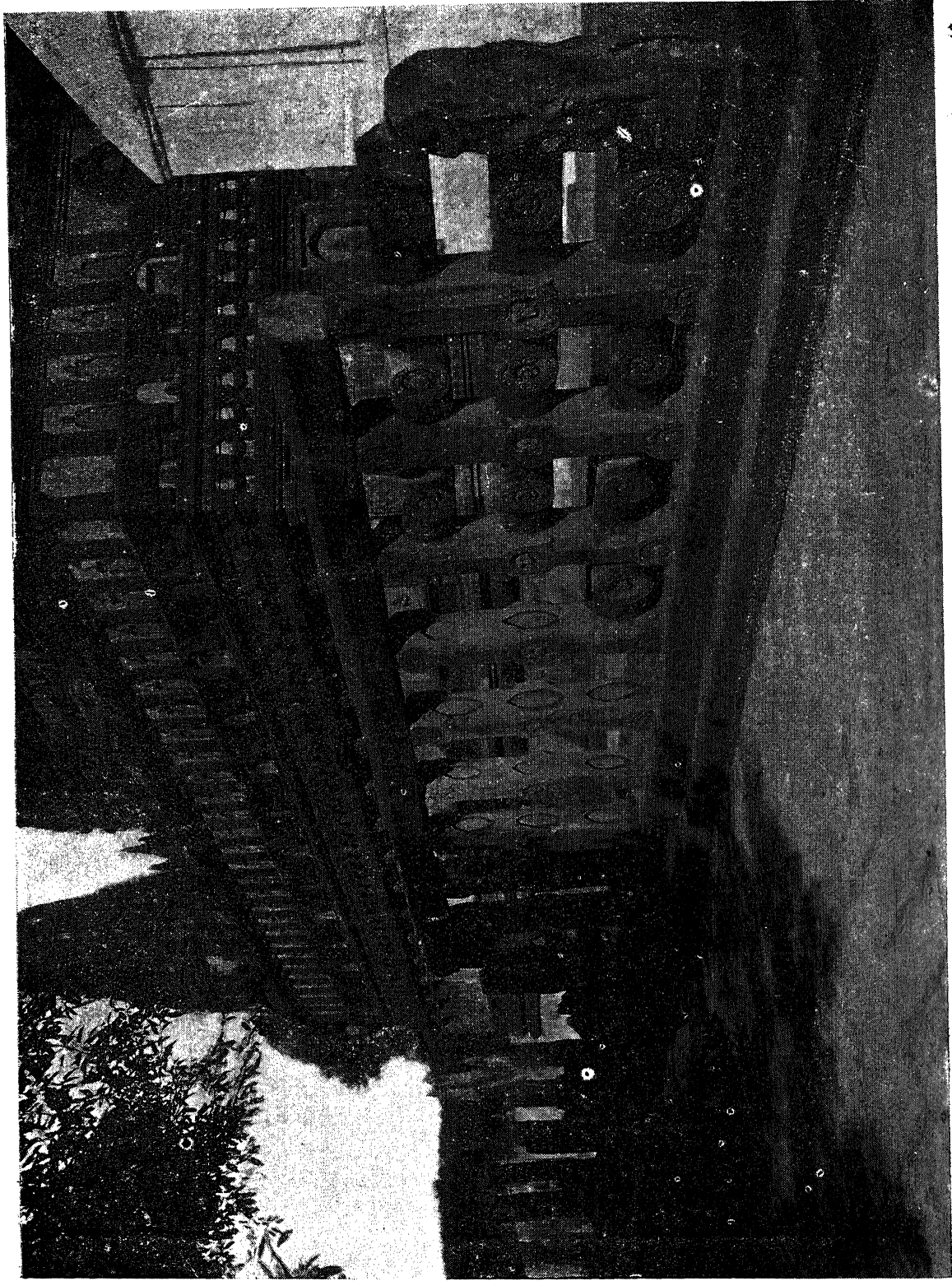
The core of the stupa consisted of a filling of earth obtained from outside, which contained a large number of terracotta figurines, cast copper coins, a few punch-marked coins, and terracotta seals of the second and first centuries B. C.; the structure therefore cannot pre-date the first century B. C.

In the shaft dug into centre of the mound through an evidently disturbed filling was found, at a depth of 14 feet, the remnants of a brick altar 3 feet high; it had been anciently truncated for reasons stated below. Further down, at a depth of 15 feet from the bottom of the altar and 35 feet from the top, was found the top of an intact miniature stupa, complete with a surmounting square umbrella. The stupa was 12 feet in height and was polygonal on plan. An examination of the interior of the stupa yielded nothing, but beside it was a tiny copper vessel with a lid fastened to it by a wire. Inside the vessel was long strip of thin birch-leaf manuscript, which, having been squeezed into it, was so fragile that it was impossible to spread it thoroughly. The bits that could be extricated were sufficient to show that the manuscript was that of a Buddhist text and was written in characters of early fourth century A. D. The fact that it was found not inside but beside the interior stupa indicates that the stupa was earlier than the manuscript and was re-consecrated about the beginning of the fourth century by devotees who had to cut through the upper altar and disturb the original earth-filling to gain access to it.

*Basarh* :—The remains at Basarh, 21 miles to the north of Muzaffarpur, were identified as representing the city of Vaisali by Cunningham, and subsequent research has confirmed the identification. Vaisali has a history going back to the pre-Buddha period. It was founded, according to the Puranas, by Visala, a descendant of Ikshvaku of the solar race. By the sixth century B. C., however, the monarchy had been overthrown, as in Buddha's time it was ruled by the oligarchic organization of the Lichchavis, a branch of the Vriji clan. Buddha visited the place more than once and delivered many sermons here. Ajatasatru of Magadha annexed Vaisali to his kingdom, after which it ceased to have an independent existence, though the city continued to be important.

The remains at Basarh consist of an oblong fortified area, 1700 feet by 800 feet, known as *Raja Bisal ka garh*. Though the history of Vaisali would lead us

Plate IV



Bodhi Gaya Railing

to expect Mauryan and even pre-Mauryan antiquities here, excavations by Bloch and Spooner in 1903-4 and 1913-4 respectively yielded objects mostly of Gupta age and only some of pre-Gupta but post-Maurya age, probably because the excavations did not touch the earliest levels. The latter class of objects consisted of terracotta figurines dating from the first century B. C. and including two Hellenistic heads, punch-marked coins and terracotta seals, one of which belonged to the sister of Rudrasena, a third century ruler of Ujjayani. The excavated buildings of all periods were poor and insignificant.

*Buxar*.—A rich collection of terracotta figurines was obtained from the bank of the Ganges at a depth of 52 feet at Buxar, District Shahabad, in 1928 by A. Banerji-Sastri. The circumstances of the discovery are not clear, nor are any data available about stratification. The discoverer, however, claimed an extreme antiquity for them, regarding them as of chalcolithic age and Aegean affinity.<sup>25</sup> The series is no doubt remarkable for the uniqueness of the head-dresses of many of the figurines, but there are features which connect it with the Sunga and Kushan terracottas of Patna and Basarh.<sup>26</sup> On the whole, it may be held that though the series holds a unique place among Indian terracottas, its prehistoric date is not established.

*Other finds*.—Isolated post-Maurya and pre-Gupta finds are rare in Bihar. The Mani-naga sculpture from Rajgir (see above) was a direct import from the Mathura region, as is revealed by its material (red sandstone), which is unknown in Bihar but is the normal sculptural material of Mathura in the early centuries of the Christian era. The only other example of the influence of Mathura art is a small grey sandstone image of a standing male figure in the Patna Museum, the pose and drapery of which are exactly like those of the Mathura Bodhisattvas.

## E. THE GUPTA AGE

The Gupta age, remarkable for the fillip it gave to Indian architecture and sculpture, started in A. D. 319, when Chandragupta, a Magadha chief, assumed the imperial title of *maharajadhiraja* and started an era of his own. He married a Lichchhavi princess of North Bihar; this event must have been an important event in his life, as it is commemorated on one class of his coins on which he is depicted as seated with his queen on the obverse and the goddess Lakshmi on the reverse with the legend *Lichchhavayah* ('the Lichchhavis') below, implying that his prosperity was due to the Lichchhavis.

The line of Chandragupta virtually ended by A. D. 500, but the traditions of Gupta art continued for a century or more after this.

*Basarh*.—Vaisali, the home of the Lichchhavis, must have gained in prosperity under the Guptas. The place abounds in seals with legends in Gupta characters,

from which it is known that the place was now the headquarters of a district ruled over by governors, some of whom were of the royal family. A large number of terracottas were found in the excavations here.<sup>27</sup>

*Rajgir*.—The cylindrical brick structure of Maniyar Math (see above) was restored during the Gupta period, though it is not known whether its Naga association continued. The wall of the structure was decorated by a row of stucco figures of Brahmanical gods, stylistically assigned to this age, each placed under a niche (plate V). The images, exposed in 1905-6, have unfortunately completely disappeared due to damages by weather.

To the north-west of Maniyar Math, at a distance of about 2,000 feet, is a group of two caves known as Sonbhandar. In spite of all legends associated with them it is definitely known from an inscription one of them bears that they were excavated in the fourth century by a Jaina ascetic for meditation. One of them is intact and bears a vaulted roof over vertical walls. The walls of the other, of which the roof has fallen, are carved with figures of Jaina Tirthankars.

A modest Jaina temple on the Vaibhara Hill contains a few inscribed Jaina images of the fifth-sixth centuries.

Minor antiquities of the Gupta age are found in many places at Rajgir, both inside and outside the valley.

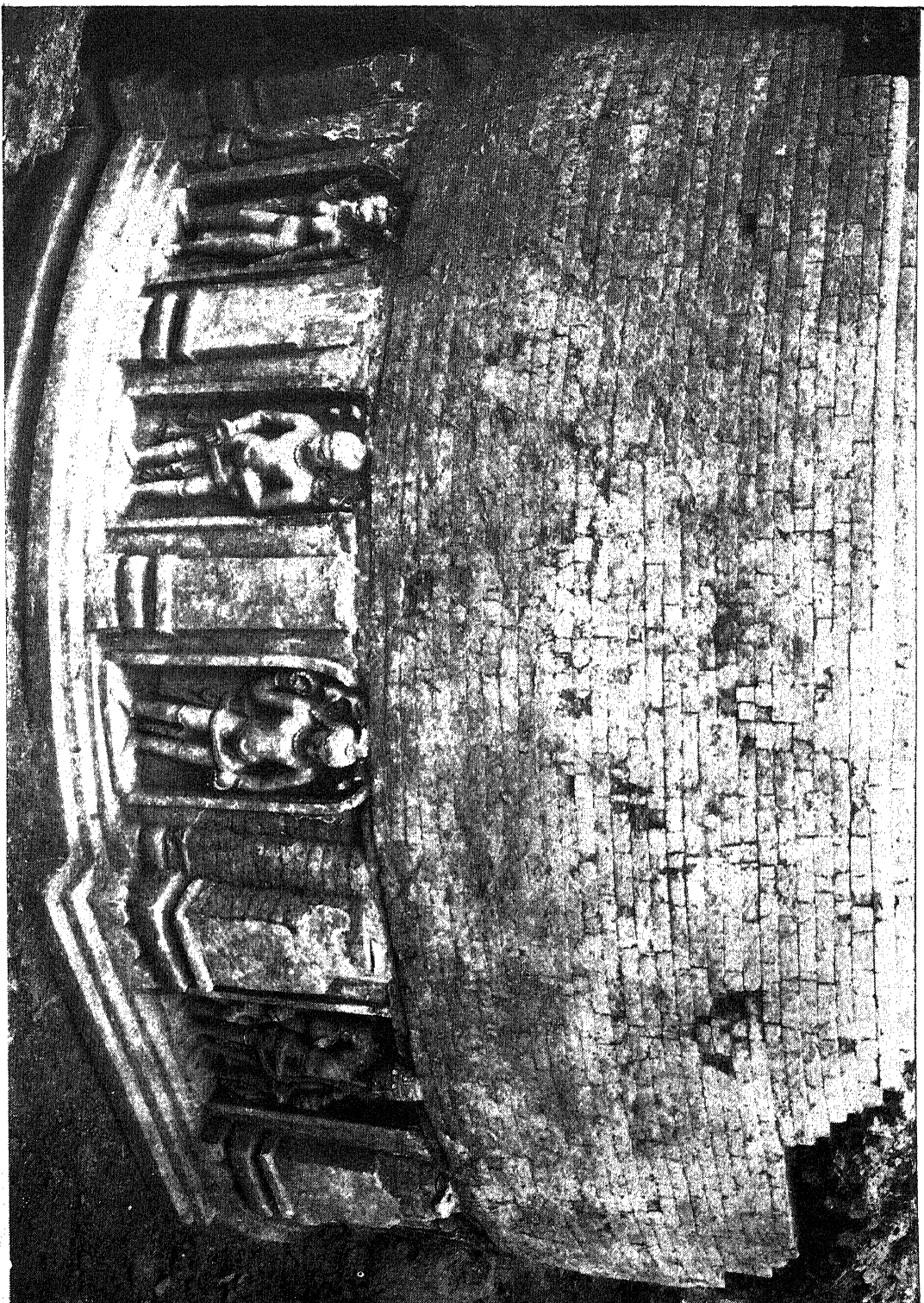
*Bodh-gaya*.—The temple at Bodh-gaya, known as Mahabodhi, as it stands now, 'is a restoration (1880-1) of the Burmese restorations of 1105 and 1298 and still earlier medieval renovations and restorations'.<sup>28</sup> It stands on a raised terrace and has a high pyramidal *sikhara* with straight edges. It is undoubtedly built over an ancient nucleus, as Cunningham, who restored the temple in 1880-1, found below it a coin of Huvishka (second century A. D.) and some architectural fragments indicating the existence of an ancient shrine on the site. Hiuen Tsang's description of the temple, as he saw it in the seventh century, tallies with the present temple in all details. This, coupled with the fact that Fa Hien of the fifth century does not mention any remarkable temple here, makes it safe to ascribe the construction of the temple with its present characteristics to the fifth century or sixth century.

Mention has been made above of the granite railing of Gupta age dovetailed into the earlier sandstone railing. It has been surmised that the enlarged plan of the temple necessitated a large number of railings, and the granite railing was designed to answer this requirement.

*Nalanda*.—The Gupta period saw the beginnings of the monastic establishments at Nalanda, the ruins of which are situated in village Bargaon, 6 miles north of Rajgir. In later centuries Nalanda became the chief agency in shaping Mahāyāna



Plate V



Stucco Images In Maniyar Math, Rajgir.

Plate VI



Stucco Images in Main Stupa, Meland.



Buddhism and Buddhist art. Buddhist tradition takes back its history to the days of Buddha himself and ascribes to Asoka the building of a temple here. But excavations have not revealed anything which suggests a pre-Gupta occupation of the site. This is confirmed by Hiuen Tsang's statement that some Gupta chiefs founded the temples and monasteries of Nalanda. Modern attempts to identify them with the existing ruins have met with scanty success, as the six centuries which separated Hiuen Tsang and the final desertion of Nalanda must have produced many new buildings and modified the existing ones<sup>29</sup>

The bulk of the ruins belongs to the post-Gupta period and will be dealt with later on. The most prominent structure on the site is the Main Stupa which was the result of seven successive accumulations, each increasing its vertical and horizontal dimensions. The constructions of all the periods were square on plan and had a shrine on the top with steps leading to it. The fifth-period structure was the most imposing; it had four corner-towers and was adorned with rows of niches enclosing well-modelled stucco figures of Buddha and the Bodhisattvas (plate VI). The date of the structure is fixed by the discovery of a brick tablet, inscribed with a Buddhist text and bearing the date 197 of the Gupta era, i.e. A. D. 516-7, inside one of the votive stupas attached to it.

The other Gupta finds consist of some coins, a spurious copperplate inscription of Samudragupta (A. D. 335 to 376) and a large number of official seals of Gupta emperors and officials and other contemporay rulers. Found in an ancient dump, they are of little stratigraphic consequence.

*Belwa*.—The mounds of Belwa (District Shahabad) were excavated in 1918-9 by H. Panday, but it is not possible to form any idea of the structural remains from the published notice. The small finds, now in the Patna Museum, consist of an interesting series of terracottas of Gupta and partly pre-Gupta date.

*The Mundesvari Temple*.—The small but elegant temple of Mundesvari on the top of the Ramgarh hill in Shahabad District deserves notice. It is built of stone and is octagonal on plan both internally and externally, with a massive square pillar at each corner. Four of the eight walls are pierced with doors at the centre, the remaining four being relieved on the outside by three niches each. The door-jambs and lintel are carved with floral designs characteristic of the Gupta period, and the former further contain the images of Ganga and Yamuna. The central object of worship is a four-faced *linga*, but there are many other images, of later date, in the *sanctum*.

An inscription found here calls the temple *Mandalesvara*; it is dated in the year 30 of a disputed era.

*Sculptures*.—The Gupta age produced at Mathura, Sarnath and elsewhere remarkable schools of sculpture, which marks the zenith of the plastic art in

India. Bihar does not seem to have developed any school in this period, though the influence of Gupta art, as evolved elsewhere, is noticeable in the contemporary stuccos of Nalanda and Maniyar Math, the Jaina figures in the Sonbhandar caves (see above) and in some stone images of Shahabad, now in the Patna Museum, as well as in the figures of gods and goddesses appearing on the terra cotta seals of Basarh and Nalanda. A colossal copper image of Buddha from Sultanganj, District Bhagalpur, now in the Birmingham Museum, is a solitary specimen of the metal sculpture of this period.

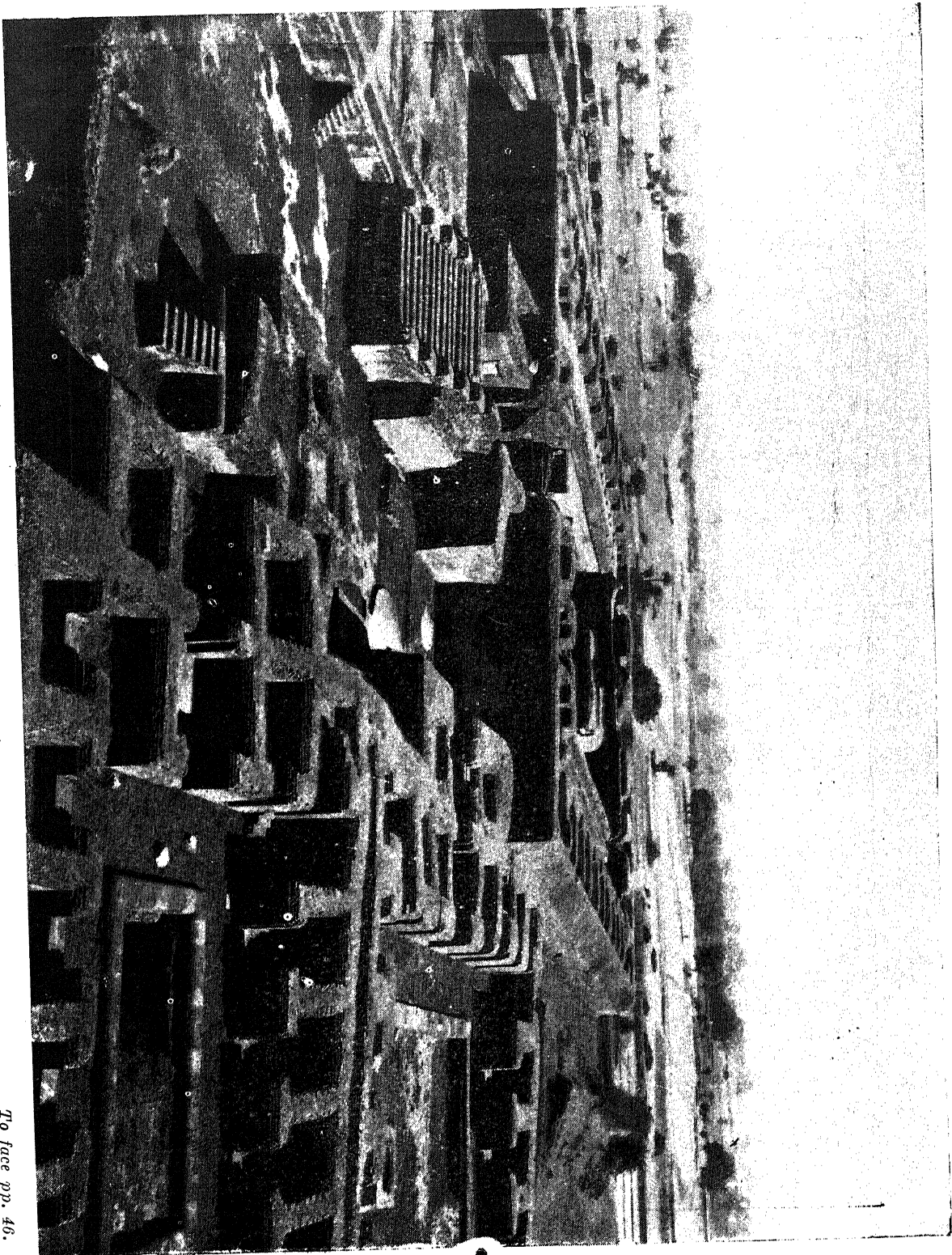
## F. THE MEDIEVAL AGE

From about 750 to 1150 Bihar and Bengal had a common political history under the Pala rulers who were Mahayan Budhists. Buddhism now flourished under royal patronage, and many new Buddhist centres sprang up all over their territory. This development is reflected in the contemporary art of the age: Buddhist monuments now predominate the scene, and Buddhist images outnumber those of other denominations. For this reason the archaeology of this period is very rich but somewhat unvaried. Eastern India now developed a provincial plastic art, of which specimens are strewn all over Bihar and Bengal. The favourite carving material was the black basalt of the Rajmahal Hills.

*Nalanda* :—Nalanda continued to be the focus of Buddhist theology. Its monks were respected all over the Buddhist world; one of them, Santirakshita, was invited by Khri-sron-deutsan to Tibet, where he lived for many years till his death in 762. About the same time Tibet was visited by Padma-sambhava, another Nalanda monk, who gave Tibet her religion. Nepal also adopted the faith as taught in Nalanda. In fact, a detailed history of Nalanda would be history of Mahayan Buddhism.

It has been said above that most of the excavated monuments of Nalanda belong to this period. They consist, generally speaking, of a row of eight monasteries, together with two other monasteries which do not conform to the general lay-out, and a parallel row of four temples. The Main Temple, of which the fifth restoration belongs to the early sixth century A. D., has been described above (see). The sixth and seventh restorations, the latter being the final, may be ascribed to a post-Gupta date. With each re-build the bulk of the temple increased, and the additional space to be enclosed was covered up by a network of small chambers which was filled up with earth and debris. There are traces of a shrine on the top of the final structure, but no image has survived.

The other three temples each consist of a central shrine on a high podium. From the existing remnants it is known that the images installed therein were of stucco; the recovered head of one such image is 3 feet high. The temples generally show two periods of construction, the latter usually confined to exten-



A Group Of Nalanda Monasteries.

To face pp. 46.



BRONZO (GILT) IMAGE FROM KURKINAR.

*To face pp. 47.*

sive repairs only. There is no means of knowing what the superstructure was like. The courts of all the temples are studded with brick or stone votive stupas, one of which, standing roughly on the level of the period of the repairs, has an inscription of the reign of Mahendrapala (882-910).

All the monasteries are similar in lay-out and general appearance (plate VII). As one enters by the front door, one finds on one side a secret chamber, access to which was provided by a very narrow and low opening in the wall. The central court is surrounded by a verandah flanked by a number of small rooms. The central room just opposite the entrance was used as a shrine with an image. The walls were all thickly plastered. Every monastery was re-built twice or three times, and in the case of one there is proof of three major restorations and several repairs. Abundant evidence was found during the excavations of an extensive conflagration which once destroyed the monasteries.

It is not possible here to give a generalized list of the varied finds from Nalanda. A large number of stone images of Buddha and Buddhist deities have been found, but considering the extent of the ruins large stone statues, common in other Buddhist centres, are remarkably few. The Nalanda artist seems to have taken delight in modelling small pieces which afforded scope for minute details. Nalanda was also the seat of a flourishing school of casting bronze images, of which no less than five hundred have been recovered. The influence of the Nalanda bronze-art spread to the Eastern Archipelago, where some of the Buddhist bronzes clearly follow the Nalanda model.

Terracotta seals and plaques form another large class of antiquities, of which the official seals of the Nalanda Monastery, bearing the legend *sri-Nalanda-Mahavihariy-aryabhikshusanghasya*, 'of the congregation of the noble monks of the great Nalanda monastery', are the most common. Hundreds of private seals have also been recovered. The ritual plaques generally consist of a deeply-sunk impression of Buddha with the Buddhist formula or mysterious Buddhist texts. Many of them were found deposited inside votive stupas.

The story of the end of Nalanda can be told in brief. Though the Pala kings bestowed munificence on Nalanda, they also established other monasteries in Bihar and Bengal, which naturally created a division in the activities of the Buddhist scholars. Buddhism itself seems to have been losing much of its popularity in the medieval age, thanks to the rise of a new phase of Brahmanism as a result of the activities of Kumarila and Sankaracharya. It appears that Buddhism gradually became detached from the laity and came to be confined to the Pala monasteries. And the final blow to the monasteries and to Buddhism was delivered by the invasion of East India in 1197 under Muhammad Bakhtiyar Khilji, to whose troops 'shaven-headed Brahmanas', i.e. Buddhist monks, were an easy target.

*Kurkihar*:—In 1930 a remarkable cache of bronze images was found in a cell among the ruins at Kurkihar, District Gaya, which is identified with the Kukkuta-pada-vihara of Hiuen Tsang. The images, numbering over two hundred of which some are gilt and with precious stone inlay, are notable alike for their technical qualities, artistic excellence and the varieties of gods and goddesses they represent. A few bear inscriptions dated in the regnal years of Pala kings, viz. Devapala (810-850), Rajyapala (908-940) and Vigrahapala II or III (960-988 or 1055-1070)<sup>31</sup>, and are thus of great importance in the study of the artistic sequence of the series. The whole collection is now in the Patna Museum,

*Bihar-sharif*:—The ruined fort at Bihar-sharif, 45 miles south-east of Patna, situated on a natural elevation, measures 2800 feet by 2100 feet and was originally surrounded by a stone fortification which has now practically disappeared. Its medieval name seems to have been Uddandapura, but that it was in existence in the Gupta period is proved by a sandstone pillar bearing inscriptions of Kumargupta (413-455) and Skandagupta (455-467). Tibetan chronicles say that Gopala I, founder of the Pala empire (750-770), built here a large monastery; consistently with this tradition, Buddhist images of medieval age, all of basalt, have been found here from time to time. The troops of Muhammad Bakhtiyar Khilji killed the inhabitants of the monastery in 1197. The earlier Muslim historians call the place Udand Bihar, and the later ones only Bihar, which has given the province its present name.

*Patharghata*:—Patharghata, on the south bank of the Ganges near Colgong (Kahlgaon), District Bhagalpur, is usually identified with the monastic site of Vikramasila, founded by the second Pala king Dharmapala (770-810), though there is no archaeological support for this identification. The remains at Patharghata consist of caves and rock-carvings, the most of the latter class being a 47 feet long frieze of sculptures, locally known as the Chaurasi Muni or 'eighty-four sages', but in reality of Vaishnavite affiliation; it dates from the seventh century<sup>32</sup> and betrays a lingering Gupta tradition.

Among the later finds from this place are some Buddhist images.<sup>33</sup>

*Bodh-gaya*:—The establishments at Bodh-gaya (see above) continued to be embellished with ancillary shrines and a considerable number of votive stupas and images. In the reign of King Alaungsithu of Burma (1112-1167), his vassal Letyaminan of Arakan extensively repaired and restored the temple.

*Other Buddhist relics*:—As has been said above, Bihar is studded with medieval Buddhist monuments, and it is possible here to name only a few. Rajgir has yielded a few stray images and terracotta plaques of this period. Near by, at Giriya, there is a lofty brick stupa and a few images.<sup>34</sup> Mention may also be made of Ghosrawan, Tetrawan and Hilsa in the Patna District,<sup>35</sup> Guneri and

Ghenjan in Gaya District,<sup>36</sup> and Lakhisarai, Jaynagar, Rajauna, Kiul and Uren in Monghyr District,<sup>37</sup> as finds-pots of important image-groups.

*Jaina Images*.—Jaina images are fewer in number, but there are notable specimens from Rajgir, from Pakbirah, Palma, Arsha and other places in Manbhum District and from Hazaribagh District. A collection of bronze images was found in 1931 at Chausa, District Shahabad, and is now housed in the Patna Museum.

*Temples*.—Barring the Nalanda and Bodh-gaya temples, little is known about the temple-architecture of Bihar in medieval days. A pre-Gupta brick temple at Deo-Barnark (District Shahabad), dating from the time of Jivitagupta II (c. 700) is a solitary specimen of its class.<sup>38</sup>

Of a different tradition is a group of Brahmanical and Jaina temples at Chhatra, Dulmi, Budhpur, Boram, Telkupi, Pandra, Deuli and other places in Manbhum District, their dates ranging from the eighth to twelfth centuries.<sup>39</sup> They are examples of Kalinga architecture as typified at Bhuvaneshwar, characterized by a curvilinear *Sikhara*, and are allied to a few temples in Burdwan and Bankura in West Bengal, which indicate the stages in the northward expansion of the Kalinga type. There is a group of similar temples, though of modest dimensions, at Haradih (near Bundu) and Diuri (near Tamar) and a solitary temple at Khekparta (near Lohardaga), respectively in the eastern, south-eastern and extreme western part of Ranchi District; situated amidst non-Hindu surroundings, they mark the westernmost outposts of Kalinga architecture.

(Note. The copyright of all the illustrations accompanying this article belongs to the Archaeological Survey of India, except that of the Kurkihar bronze image, which belongs to the Patna Museum.)

## Notes

1. J. Coggin Brown, *Catalogue of the Prehistoric Antiquities in the Indian Museum* (Simla, 1917), p. 67; A. C. Logan, *Old Chipped Stones of India* (Calcutta, 1906), pp. 32-3.

2. C. W. Anderson, 'Notes on Prehistoric Stone Implements found in Singhbhum District', *Jour. B. & O. Res. Soc.*, III (1917), pp. 349ff. Some palaeoliths were also collected from near Chakradharporo by M. Ghosh, 'Rock-paintings and Other Antiquities of Prehistoric and Later Times', *Mem. Arch. Surv. Ind.*, No. 24 (Calcutta, 1932), pp. 3ff. E. F. O. Murray found in Dhalbhum, Singhbhum District, 'a most extensive series of palaeoliths', 'The Ancient Workers of Western Dhalbhum', *Jour. Roy. Asi. Soc. Beng.* VI (1940), pp. 78ff., but the illustrations show only microliths and neoliths.

3. In the latest excavation of the Archaeological Survey of India at Brahmagiri in Chitaldrug District (Mysore State) microliths have been found in a level in which polished stone axes, pounders and discs, rarely mixed with copper and bronze objects, occur freely. This culture was overlapped in its last phase, and was ultimately supplanted by, an Iron Age culture



approximately in the fourth century B. C. This shows that at least one phase of the microlithic culture was coeval with the late Neolithic and early Iron Age.

4. Brown, *op. cit.*; pp. 122ff.

5. Brown, *op. cit.*; Anderson, *op. cit.*; Murray, *op. cit.*; S. C. Roy, 'Note on Some Prehistoric Stone Implements found in Ranchi District', *Jour. B. & O. Res. Soc.*, II (1916), pp. 61ff. There are specimens from all these places in the Patna Museum.

6. For example, S. C. Roy, 'Distribution and Nature of Asur Sites in Chota Nagpur' *Jour. B. & O. Res. Soc.*, VI (1920), plates XX and XXI. Most specimens of Roy's collection are in the Patna Museum.

7. Brown, *op. cit.*, pp. 140-2.

8. A. Campbell, 'Note on the Occurrence of Copper Celts in Manbhum', *Jour. B. & O. Res. Soc.*, II (1916), pp. 85ff. There are some copper objects in the Patna Museum recorded as from Manbhum, but there is no means of ascertaining if they are the same as Campbell's collection.

9. Murray, *op. cit.*

10. The following paragraphs will show that these sites may not in reality be prehistoric, but they have been included here under the prehistoric period as, though their date is uncertain, it is difficult to affiliate them to any known historical culture.

11. *Jour. B. & O. Res. Soc.*, I (1915), pp. 61ff.; II (1916), pp. 61ff., VI (1920), pp. 393ff.; XII (1926), pp. 147ff.

12. E. T. Dalton, *Descriptive Ethnology of Bengal* (Calcutta, 1872), pp. 202-3. I found some Christian tombstones with modern Nagari inscriptions beside some undoubtedly old burials at Hansa, three miles south-west of Khunti.

13. For the ruins of Rajgir, see *An. Rep. Arch. Surv. Ind.*, 1905-6 (Calcutta, 1909); 1913-14 (Calcutta, 1917); M. H. Kuraishi and A. Ghosh, *A Guide to Rajgir* (Delhi, 1939).

14. L. A. Waddell, *Report on the Excavations at Pataliputra* (Calcutta, 1903); J. D. Beglar, *Arch. Surv. Ind.* VIII (Calcutta, 1878), p. 24.

15. *An. Rep. Arch. Surv. Ind.*, 1912-3 (Calcutta, 1915), pp. 53ff.; *Progress Rep. Arch. Surv. Ind. East Circle*, 1912-13, pp. 55ff; 1913-4, pp. 45ff; 1914-5, pp. 45ff; 1915-6, pp. 27ff.; *Jour. Roy. Asi. Soc.* (London), 1915, pp. 63ff.

16. *An. Rep. Arch. Surv. Ind.* 1926-7 (Calcutta, 1930), pp. 135ff.

17. *Ibid.*, 1935-6 (Delhi, 1938), pp. 54-5.

18. *Ibid.*, 1936-7 (Delhi, 1940), plate XIII (a).

19. *Arch. Surv. Ind.*, I (Simla, 1871), pp. 68ff.; XVI (Calcutta, 1883), pp. 104ff.; XXII (Calcutta, 1885), pp. 47ff.

20. *An. Rep. Arch. Surv. Ind.*, 1906-7 (Calcutta, 1909), pp. 119ff.

21. *An. Rep. Arch. Surv. Ind.*, 1935-6 (Delhi, 1938), pp. 55ff.; 1936-7 (Delhi, 1940), pp. 47ff. Though Majumdar holds that the Lauriya mounds may belong to the Maurya period, not an unlikely conclusion, in the absence of definite evidence it is at present not safe to assume a large lapse of time between them and the Nandangarh mound, which is definitely later.

22. *Arch. Surv. Ind.*, I (Simla, 1871), pp. 55ff.

23. *An. Rep. Arch. Surv. Ind.*, 1903-4 (Calcutta, 1905), pp. 81ff.; 1913-4 (Calcutta, 1917), pp. 98ff.



24. D. H. Gordon, 'Early Indian Terracottas', *Jour. Ind. Soc. Orient. Art*, XI (1943), pp. 157 and 164.
25. 'Remains of a Prehistoric Civilization in the Gangetic Valley', *Jour. Bombay Hist. Soc.* III (1930), pp. 187ff.; *K. B. Pathak Commemoration Volume* (1934), pp. 248ff.
26. St. Kramrisch, 'Indian Terracottas', *Jour. Ind. Soc. Orient. Art*, VII (1939), p. 108; Gordon, *op. cit.*, p. 150.
27. For references see note 23 above.
28. A. K. Coomaraswamy, *History of Indian and Indonesian Art* (London, 1927), p. 81. For Bodh-gaya, see A. Cunningham, *Mahabodhi* (London, 1892), and B. M. Barua, *Gaya and Buddha-gaya* (Calcutta, 1934).
29. For the Nalanda excavations see *An. Rep. Arch. Surv. Ind.*, 1915-6 to 1936-7 (Calcutta and Delhi, 1918-40); A. Ghosh, *A Guide to Nalanda* (Delhi, 1939).
30. *An. Rep. Arch. Surv. Ind.*, 1918-9, Part I (Calcutta, 1921), p. 16.
31. R. C. Mazumdar, *History of Bengal* (Dacca, 1943), pp. 173ff.
32. *An. Rep. Arch. Surv. Bengal Circle*, 1902-3 (Calcutta, 1903), p. 8.
33. R. D. Banerjee, *Eastern Indian School of Mediaeval Sculpture* (Delhi, 1933), pp. 23 etc.
34. *Arch. Surv. Ind.*, I (Simla, 1871), pp. 16 ff.; also R. D. Banerjee, *op. cit.*
35. *Arch. Surv. Ind.*, III (Calcutta, 1873), pp. 66ff.
36. *Ibid.*, VIII (Calcutta, 1878), p. 63.
37. *Ibid.*, III (Calcutta, 1873), pp. 151ff.
38. *Ibid.*, XVI (Calcutta, 1883), p. 64.
39. *Ibid.*, VIII (Calcutta, 1878), pp. 155ff.; *An. Rep. Arch. Surv. Bengal Circle*, 1902-3 (Calcutta, 1903), p. 14.

# ANTHROPOLOGY IN BIHAR

*By*

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Systematic anthropology in Bihar had its beginning with the publication of Roy's "The Mundas and Their Country" in 1912.

Bihar with her variable mankind, aboriginal, semi-aboriginal and civilised, is a fruitful field for the study of man himself. Clark Wissler has said in his introduction to the famous "Middletown": "To study ourselves as through the eye of an outsider is the basic difficulty in social science and may be insurmountable but the authors of this volume have made a serious attempt, by approaching an American Community as an Anthropologist does a primitive tribe." To the present writer it appears that this "Eye of an outsider" in Anthropology is the greatest obstacle to its furtherance in this country. Everywhere among both the civilised and the uncivilised the field anthropologist is faced with the question "What's the use?" It is difficult to explain both to the civilised and the uncivilised the use of anthropology in a few words, but it can be partially got rid of by opening Anthropology in all the Indian Universities. Anthropology can help a lot in the unity of man in this country—a dire necessity in these days of communalism—as Chatterjee (1932) has shown that there is no physical difference between the Maithil and the Kanaujia Brahmans of Bihar; as Sarkar (1935) has shown that the Malers and the Malpaharias of the Rajmahal Hills (Santal Pergs.) are one and the same aboriginal tribe. Anthropology can help to explain the innate biological variabilities from man to man, tribe to tribe and thus forecast the probable expansion or extinction of a people and the remedies possible for them. Anthropology, if rightly pursued, can never accelerate race prejudices, rather rendering a complete knowledge of its wide sphere of action helps mutual understanding. How do the Santals and the Malers live side by side peacefully with their totally different physique, culture and language? And they joined together during the Santal rebellion of 1855 against the British. It is a lesson for all those who want a political unity in this country.

Bihar has an aboriginal population of about 4 millions. It will be of interest first of all to give a brief description of some of the major tribes and castes.

The Santals form the largest aboriginal population of Bihar. In the Census of 1941 they were 1,534,646, which shows an increase of 153,916 (11%) above the



Hill Maler, Maharajpur, Blood Group, O.



Hill Maler, Berhait Blood Group, O.

Census figure of 1931. They are rapidly increasing and the population pressure has been so great that they have been compelled to migrate into the adjacent provinces. They are a Mundari-speaking people with short stature, long high vaulted head and thickset body. The lesser growth of facial and body hair, high cheek bones, etc. point to a Mongolian admixture. Thanks to the missionary enterprises Santali language has been ably romanised and is the only aboriginal dialect accepted for the Marti-culation Examination of the Patna University since 1942. The Santals enjoy a special territory of their own known as Santal Perganas and within the district an area of 1556 square miles known as Damm-i-Koh has been a sort of protected area for them. It appears that they entered India from the east along the coastal regions with the Austric-speaking peoples.



Santal Brindabani, Blood Group B.

In the same geographical territory of the Santals we come across the Malers, one of the most primitive peoples of Bihar. They are primarily a hill-people, though a few of them are found in the plains. These hill-people once formed the Bhagalpur Hill Rangers raised by Cleaveland during the regime of the East India Company. The Malers are a Dravidian-speaking people with skin colour darker and stature shorter than the Santals. They possess many other infantile characters so common among the jungle-folks of India having a Veldoid ancestry. The Malers are gradually decreasing in numbers. They numbered 58,654 in 1941 in Bihar as compared with 59,891 of 1931 figure. A remarkable feature in their social organisation is the absence of clan system.

The Oraons of Ranchi rank next to the Santals in population and are thus the second largest aboriginal people of Bihar. They numbered 638,490 in 1941 as compared to 552,688 of 1931. The Oraons are a Dravidian-speaking people, and as such Sarat Chandra Roy on the basis of a tradition present among them but not among the Malers and a few other common cultural features maintained an affinity with the Malers of the Rajmahal Hills mentioned above. Recent researches of the present author (1942-43) have however proved that the Oraons are altogether a different people, who migrated from the South at a much later date than the Malers. The physical characteristics of the Oraons were studied by the

late Dr. P. C. Bose (1933-34) of Bose Research Institute in which he found the Oraons to be a medium-statured, long-headed, medium-nosed people with strong



Dolichocephalic Chamaerrhine adult Oraon male

well-built bodies. The Oraons have been the subject of Roy's two valuable monographs (1915, 1928) in the last of which he went deep into the religious life of the



Oraon mother and child, Blood Group of both, A. B.

tribe. A feature of the Oraon tribal life is the relatively important role of their women in almost all social functions even at the time of disposal of the dead,

Occupying the same locality of the Oraons there is another tribe known as Mundas. The Mundas are a Mundari-speaking people and their linguistic affinity with the Santals, Hos, etc. is also probably ethnically related. Basu (1932-33) undertook a comparative anthropometric survey of the Mundas and Oraons and found them unrelated. He found the Mundas slightly shorter than the Oraons. Both the Mundas and the Oraons are long-headed but there is a difference in the cranial vault, and the broad-headed element is perceptibly higher among the Oraons. The nasal profile is higher in the Mundas than the Oraons and there is a difference in the total facial form. The Mundas number 519, 473 in 1941 as compared with 467, 720 of 1931. Roy's earliest study of the Munda social organisation has already been mentioned.



Mesoccephalic Chamaerhine adult Munda male

Roy and Roy (1937) published two volumes on the Kharias who number 88,777 in 1941 as compared with 85,360 of 1931. Only the Dudh Kharias are found in Ranchi district. The other two groups, Dhelki and Hill Kharia, who are somewhat less civilised than the Dudh group are found in the neighbouring Orissa states. The Kharias are also a Mundari-speaking people and appear to be closely related to the other Mundari-speaking peoples.

The Hos of Singbhum, another tribe of the Mundari group, number (according to the Census of 1931) 301,158 as compared with 349,645 of 1941.

Apart from the somewhat larger aboriginal tribes mentioned above there are as yet quite a good number of smaller tribes who are yet in a semi-nomadic state of existence living mainly on hunting and the produces of the jungles. The Birhors of Chota Nagpur on whom Roy contributed a volume in 1925 deserve special mention. Their nomadic life makes the task of an anthropologist all the more difficult and their love for the flesh of the longtailed monkey (*Semnopithecus entellus*) is a peculiarity of this tribe. They number only 2,499 in the Census of 1941 as compared with 2,350 of 1931.

The Asuras, the primitive iron-smelters of Bihar also known as Lohars in Palamau and Ranchi, are a scattered group of people earning their livelihood by the manufacture of iron tools and implements. Iron smelting is now prohibited by law and they now purchase iron from the market. Roy (1920) published several accounts of "Asur garhs" and "Asur sasans" in the journal of the Bihar and Orissa Research Society and was of opinion that the Asur sites date back to the neolithic times. Roy (1932) is of opinion that the Asuras are "near kinsmen of the Mundas." The Asura population comprises 2,024 souls in 1931 as compared with 4,388 of 1941.

The smaller aboriginal tribes who are mostly on the verge of extinction either by natural death or by acculturation deserve immediate attention of the anthropologists. Nothing is known of the Birjias who numbered only 1550 souls in 1931. They are believed to be closely allied to the Asuras. The Pahiras, a very interesting people, locked up in the Dolma Hill Range of Manbhum, deserve immediate attention. Roy (1920) referred to their habit of wearing bark clothes at times of distress. They numbered only 150 souls in the Census of 1931. Equally interesting will be a study of the Khetauri of Santal Perganas, who are once believed to be the local kings and the remnants of their forts (garh) abound in the district. Mention must have to be made of the Mongoloid Tharus, the real Mongoloid tribe of Bihar, inhabiting the terai district of Champaran. The Tharus of the U. P. Terai districts have been the subject of study of the Lucknow School of Anthropology.

Besides the aboriginal populations mentioned above there are a few other tribes which no longer deserve to be called aboriginal. The Bhuiyas, who mostly abound in the many districts of North Bihar and the Bhuiyas who correspondingly abound in the southern part of the province openly profess Hinduism and deserve to be fully classified as Hindus. The Cheros and the Kharwars of Palamau also deserve the same treatment.

Anthropology does not rest with primitive peoples alone. Much remains to be done among the upper class societies. In Bihar the Maithil and the Kanujia Brahmans have been the only upper classes to be studied.

In Bihar the Ahirs or the Goalas outnumber all other castes in population. They were 3,455,141 in 1931. The next in population strength was the Brahmans with the figure of 1,536,370 for 1931. The following castes rank in the millionth figure: Chamar, Dosad, Koiri, Kurmi, Teli and Rajput. The Chamars, Dosads and the Kurmis are the only three castes which have numerically a higher number of women among them and their sex ratios are 110.0, 103.8 and 100.3 respectively.

All the other castes show a shortage of women, the maximum of which is met with among the Kayasthas of Bihar with a sex ratio of 89.8. This is closely followed by 90.2 among the Rajputs. The predominant Ahirs of the province have a

sex ratio of 95.7. A thorough enquiry into the sex ratio of this country, not to speak of Bihar alone, is urgently required to assess properly the gradually increasing population of India.

In the preceding pages only a bare outline of the manifold functions of anthropology has been given. Anthropology is not limited to these few only. It is concerned with every sphere of human activities. Each tribe, each population group, presents a problem of its own. This requires first of all a thorough systematic study. In Bihar, marriage problems deserve a very careful survey. Social customs and manners are fast changing, but whether the bad only are being ousted is still unknown. The elimination of bad elements from the society is sure to lead finally to the elimination of dysgenic elements from amongst a group of people and that alone can help it in the common race of struggle for existence.



# THE GEOLOGY AND MINERAL RESOURCES OF BIHAR

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*By*

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## Introduction

The province of Bihar covers an area of about 69,348 square miles and extends from the foot of the Himalayas over the plains of the Ganges and the Kosi and the plateau of Chotanagpur. The population of Bihar according to the last census in 1940 was 3,64,00,000. Bihar forms one of the most important areas in India from a geological point of view and also the richest mineral province in India. Almost every mineral excepting petroleum has a major or minor representative deposit in the area. In fact, Bihar plays an important role in the mineral production of India as a whole and its mineral wealth formed the real backbone of the war effort for the successful termination of the war in S. E. Asia.

Of the important mineral industries of India, 14 in number, which consist of the following :—coal, iron, mica, gold, manganese, copper, limestone, tin, salt, lead, silver, zinc, petroleum and saltpetre, Bihar leads in the first three above-mentioned minerals, e.g., coal, iron, and mica and is perhaps second in copper and saltpetre.

## Geological Education In Bihar

Although the province is very important from its geology and mineral wealth, geological education had not made any start in the country. It was only recently that with the foundation of the Tata Professor of Geology with the munificent grant made by Messrs. J. N. Tata Sons & Co., Jamshedpur, the Patna University opened its geological department for post-graduate work. It is hoped that good students would take advantage of this opportunity and furnish Bihar with good geologists to play a leading part in the development of its mineral wealth.

## Geology of Bihar

Just as India is divided into distinct physiographic divisions according to its geology, Bihar is also divisible into two areas, e.g., (1) in the north the Gangetic plains, forming a typical alluvial country and (2) in the south the Chotanagpur plateau and its eastern environs, consisting of granitic rocks with associated metamorphic and basic igneous rocks, in which occur large areas of sedimentary rocks consisting of the Gondwana coalfields.

A study of the geology gives the correct perspective of the mineral resources of the area. There is always a relation between the geology and the mineral resources of the area.

The following is the sequence of geological formations in Bihar:—

	Recent—Alluvium (newer). Pleistocene—the older Gangetic alluvium or 'Bhangar', and laterite.	
Aryan Era	Pliocene (Upper and Middle)	Upper Siwaliks and Lower Siwalik formations of the Himalayas.
	Miocene— Lower Miocene Oligocene Eocene	
	Cretaceous Jurassic (Lais)	Tertiaries of the Himalayas
		Upper Gondwanas—Rajmahal series consisting of Rajmahal bedded basalt (trap), with inter-trappean beds in Santhal Parganas. Dolerite intrusions in the coalfields.
	Triassic	Panchet beds of Raniganj, Kāranpura, Bokaro and other coalfields.
		Damuda-series { Raniganj stage, Iron-stone shales and Barren measures, Barakar coal measures.
	Carboniferous (Permian) L. Gondwanas	Talchirs (includes Karharbari stage), developed in the coalfields of the Damodar and Koel River valleys as well as in the Santhal Parganas and in Orissa States. All these rocks are intruded by mica peridotite as dykes and sills.
Dravidian Era	Devonia Silurian Cambrian	Unrepresented.
Puranic Era	Vindhyan limestones etc. of Palamau district. Newer dolerite.	
Vedic or Archaeon Era	Kolhan series. Granite and related rocks. Iron Ore series, including other sedimentary and igneous schists of probably equivalent age.	

### The Archaeon System

The strike of the Archaeon rocks is generally east to west, but in the southern border of the province some divergence is found. The Archaeon rocks occupy more than nine-tenths of the province, south of the Gangetic alluvium. The remaining one-tenth is covered by the Gondwana sediments, which form the coalfields and small areas of the Vindhyan and the Deccan Trap.

The Archaeans could be subdivided into two main groups:—(1) Sedimentary rocks associated with extrusive lavas and intrusive igneous rocks, (2) the great granite

intrusions which dominate the central areas of Chotanagpur from east to west. The sedimentary and basic igneous groups dominate in northern and southern Chotanagpur.

1. The sedimentary rocks in the north occur south of the Ganges as ridges of quartzite and quartz in Gaya and Monghyr districts. Slate and phyllite also occur. On the dissected edges of the Chotanagpur plateau occur large areas of mica-schist, quartz-schists and hornblende-schists which are permeated by innumerable intrusions of granite yielding hybrid rock types. Further south rises the Hazaribagh plateau with minor inclusions of mica-schist quartz-schists etc., but the whole of the central plateau, i.e., Ranchi district, is granite.

The sedimentary group, well-known as the "Iron Ore series," is best developed in south Ranchi, Manbhum and Singhbhum, and includes rocks relatively unmetamorphosed to highly metamorphosed. Sandstones, conglomerates, quartzite, quartz-schists, phyllites, garnet-mica-schists, limestone, calc-schists and banded hematite-quartzite. The associated basic lavas etc. now occur as epidiorite, hornblende-schists, and talc-schists. The most important in the Iron Ore series is the banded hematite-quartzite, which forms the rich iron ores. A group of sandstones, conglomerates, shales and limestones has been separated from the Iron Ore series and is called the 'Kolhan series', whose stratigraphical position has not been fixed. It may be Archaean or Cuddapah.

2. The great mass of granitic rocks, formerly known as the Bengal gneiss, occupying the central part of Chotanagpur, show intrusive relations to the schists both in the north and south. The granite has also been given local names, e. g., Singhbhum granite, but is generally known as the Chotanagpur granite. It is often gneissic or schistose towards its borders. It varies from a biotite-granite to a hornblende-granite, fine to coarse-grained, porphyritic and also containing ovoid felspars. Pegmatite veins are also associated with granite. Where the pegmatite veins penetrate the mica-schists, they often contain large crystals of mica as in Hazaribagh, Gaya and Monghyr districts. Granites of different ages occur in Bihar as in the copper belt.

3. Basic igneous dykes are found to be intrusive into the Singhbhum granite and rocks of the Iron Ore series. These have been called the newer dolerite. They may belong to the Cuddapah or even to the Deccan Trap. They also bear similarity to the pre-Vindhyan dykes of Bundelkhand in Central India.

4. The Vindhyan rocks cover a very small area in the extreme western part of the province. This is the eastern end of the Kaimur plateau. The following rocks are found in it:—sandstone, quartzites, limestones, dolomitic limestones, and shales.

5. The Gondwana rocks occupy basin-like structures with an east to west trend and lie in the directions of Auranga and Damodar valleys. Other Gondwana

lie also outside this strike, e. g., the Giridih coalfields. The main rock formations are sandstones and shales, but the coal seams occur in sandstones.

The following is the sequence given by Fox and Gee of the Gondwana rocks in Bihar :—

<i>Raniganj Field</i>		<i>Jharia Field</i>	
Panchet series	Hirapur stage Maitur stage Kumarpur sandstone	Not represented.	
Raniganj stage	Nituria coal measures Hijuli sandstones 3,300 ft.	Lolipiti sandstone Telmuch coal measures Jamdiha sandstones Murilidih coal measures Matuda sandstones	Raniganj series 1,840 ft.
Ironstone shales 1,200 ft.	Ethora sandstones Ironstone (Kulti) shales	Hariharpur carbonaceous shales Patia sandstone Shibbabudih shales	} Barren measures 2,000 ft.
Barakar series 2,100 ft.	Begunia sandstones Begunia shales Begunia seam Laikdih seam Damagaria seam	Sitamala seam No. XVIII, XVXIII seams etc. Muriadih seam	
			} Barakar series 2,000 ft.

Unconformity in which Karharbari stage may be missing.

Talchir series	Talchir needle shales. Talchir boulder bed. Great Unconformity.
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6. Rajmahal traps. Rajmahal traps occur in the eastern part of the Santhal Parganas overlying the Gondwana sediments. Dykes belonging to them also penetrate the Gondwana sediments. Some ultra-basic intrusions have also altered the coal.

In Ranchi and Palamau districts, the Deccan trap covers flat plateaus rising to 3,000 ft. The trap has altered to laterite and to bauxite in places.

7. The Siwaliks are found in the Champaran district and consist of conglomerate and sand rock.

8. Laterite occurs at various heights, e.g., 3,000 ft. in Ranchi and Palamau, at 1,600 ft. in the Rajmahal hills on the western scarps and passes down to the level of the Gangetic plains.

9. The Gangetic alluvium occupies all the northern districts of Bihar on both sides of the Ganges.

### Localisation of Minerals and Prospecting

Certain mineral deposits are related to particular rock types. The mineral deposits are shown according to geological formations which they have been found to accompany. Mineral occurrences of minor importance are shown within brackets.

*Archaean sedimentary rocks*—Iron-ores, manganese ore, limestone, dolomite, kyanite, refractory quartzite, steatite (potstone), chert, quartzite, slate, building stones, china-clay, ochres: (graphite, garnet, topaz, corundum, aluminium sulphate).

*Archaean basic igneous rocks*—Chromite, steatite (potstone), vanadium bearing iron-ores; (asbestos, magnesite, magnetite).

*Granite*—China-clay, building stone, road metal.

*Pegmatite veins*—Mica, felspar (beryl, rose quartz, apatite, columbite, tantalite, cassiterite, monazite, pitchblende, tourmaline triplite).

*Other veins in Archaeans*—Copper, apatite, magnetite, gold, barytes, quartz, (wolfram, lead).

*Kolhan series*—Building stones, iron-ore manganese ore, limestone.

*Newer dolerite*—Road metal, railway ballast.

*Vindhyan system*—Limestone, sandstone, shale, glass sand, pyrite, (alum shale iron sulphate).

*Gondwana system*—Coal, fire-clay, china-clay, sandstone, glass sand, (iron-ore, shale, limestone, fuller's earth).

*Traps*—Road metal, building stone, (agate, amethyst, opal).

*Sivaliks*—(sandstone).

*Tertiary*—Gravel, ballast for railways and concrete.

*Laterite*—Building stone, bauxite, lithomarge, iron-ore, manganese ore.

*Gangetic alluvium*—Kankar, saltpetre, sodium sulphate, reh.

*Recent alluvium*—Brick and pottery clays, sand, kankar, earths for cement manufacture, iron-ore, manganese ore (gold, platinum).

### Geographical Distribution

It will be useful to indicate also the extent to which our geological knowledge can serve as a guide to the areal distribution of minerals, so that the prospector can concentrate his search for individual mineral deposits.

N. Bihar—north of the Ganges; kankar, saltpetre, sodium sulphate, reh, sands and brick clays.

*Central and S. Bihar*—Main mineral deposits arranged in parallel zones.

(1) Mica deposits occur in an east-west belt, 60 miles south of the Ganges.

(2) Coalfields occur in a belt, south of the mica-fields extending from Raniganj in the east to Hutar in the west. Some smaller coalfields occur to the north, of which Giridih is the largest. Most of the refractory clays also occur in these basins.

3. A belt of Archaean limestone deposits runs from near Ramgarh to the western side of the Koel River south-west of Daltonganj. Its strike is parallel to that of the coalfields and is in close vicinity. Away from this belt, limestone deposits of Vindhyan age occur at the edge of the Kaimur plateau near the Sone River.

4. Still further south, west of Lohardaga is the zone of bauxite deposits.

5. At the southern end of the province is the rich mineral district of Singhbhum, which in its eastern and northern parts has deposits of kyanite rocks, apatite-magnetite veins, and copper lodes. The above minerals occur in a belt 80 miles long and 3 miles wide, but narrowing down in places to a few hundred yards. The mineralised bands occur from north to south as given below:—kyanite rocks, apatite-magnetite veins, and copper veins on the southern margin. South of the copper belt, west of Chaibasa in central Singhbhum, the chromite belt is located. In the southern part of Singhbhum, kaolin deposits occur associated with the granite, and in the south-west corner lie the iron-ore and manganese deposits.

## II. Bihar's Mineral Wealth and Industry

Bihar is the premier mineral province of India both from the richness and diversity of the minerals produced as well as their monetary value. The mineral production of Bihar and its values from 1940-1944 are given in the appendix. A large part of the value of Bihar's mineral production is represented by coal. Coal forms the main source of power for much of the world's industry, which is the case in India also. It is fortunate that vast deposits of high-grade iron-ore occurs in Bihar. The iron-ores with the coal deposits have given rise to the great and important industry—the iron and steel manufacture at Jamshedpur, the great metallurgical centre in the country (within the province) and at Asansol (just outside it). Besides iron-smelting, other subsidiary industries have also grown up there. Thus much of India's industry in the east is based on Bihar's coal. Again, near Ghatsila in Singhbhum, the only copper smelting industry of India is located. India gets her brass requirements to a great extent from here. Hazaribagh produces most of the world's high-grade mica and of mica splittings. In fact, Bihar controls the world's supply of high-grade mica. The above form the most important mineral industries, which provide work for many thousands of people and contribute a great deal to the development of the country. It may justly be said that Bihar's mineral industry was the backbone of India's great war effort. Most of Bihar's minerals are utilised

in the local industries, but many of them are exported also. Bihar can derive maximum benefit only when her industries develop and use her minerals. The iron-ores, coal and manganese produced in Bihar could all be used in Bihar alone, but wasteful methods of mining as in the case of coal have to be avoided.

The reserves of coking coal are limited, but still the coking quality coal is used for steam raising. The competition in mining high-grade coals results in the neglect of the overlying low-grade coals which are destroyed resulting in the loss of vast reserves. It is highly necessary that coal mining is done on a regular system, i.e., from top to bottom of all coking and non-coking coals, both inferior and superior, which would give maximum extraction and the exhaustion of all the seams together. This may lead to vast changes in marketing and the use of coal. There is great scope for further research on coal and its by-products for better use etc.

The world war gave a great impetus to the expansion of India's mineral industry and Bihar enjoyed her share in it. The industries which are well established are coal, iron, copper, mica, clay and limestone. Aluminium has been recently started and has a great future before it.

### 1. Coal

Bihar coalfields produce over 50% of India's annual output of coal. The Jharia coalfield alone produces about 40% of India's coal and forms the most important source for the best coking coal for India's metallurgical industry. Almost the whole output of India's coal is consumed in the country. There is a little export to Ceylon, Hong-kong, etc. Consumers of Indian coal are (1) Railways 33 $\frac{1}{3}$ %, (2) Iron and steel 25%, (3) Collieries 10%, (4) ships 6%, and other consumers 25 $\frac{2}{3}$ %.

Hard coke manufacture takes 2 million tons of coal per year in Bihar, and only a small percentage of Bihar's coal reserves is suitable for manufacturing into hard coke, but with suitable blending other coals could also be used.

Soft coke is also manufactured for domestic use from inferior coals. In Bihar one million tons of coke are manufactured. The by-products in the manufacture of coke are being collected in most plants.

The coal for export is suitably graded according to standards set by the coal grading board, which was constituted in 1925. Considerable variation has been noted in the quality and character of the coal in the different seams of one field as well as from one field to another.

*Occurrence.* The coal reserves of Bihar entirely belong to the Gondwanas. The coal seams are confined to the Lower Gondwanas—to the Barakar and Raniganj stages, which with the intervening Barren measures have a thickness of 7,000 ft. In the Barakar stage, the lower stage in the Jharia coalfield there

are 18 workable seams totalling 200 ft. thickness of coal : in the Raniganj coalfield in the Raniganj stage, there are six important seams, but they are largely outside the limits of Bihar. Some seams are even 40 ft. in thickness and are laminated and well-bedded.

There are 21 coalfields in Bihar, 5 arranged along the western edge of the Rajmahal hills, 9 along the Auranga-Damodar valleys, and 7 in a belt to the north and parallel to the latter. The following are the fields described according to the districts :—

### I. Manbhum District

(1) *Raniganj Coalfield*. It is about 600 square miles in area and is mostly in Bengal. In the seams of the Barakar stage, steam coals of good quality and hard coking coals are also obtained. The Raniganj coals are either non-coking or produce a soft coke. The better quality coals are good gas coals and free-burning steam coals. The Dishergarh and Sanctoria seams are well-known. Total reserve is about 22,000 million tons of which 408 million tons are of coking quality.

2. *Jharia Coalfield*. The total area of this coalfield is about 175 square miles. A large part of the area is covered by Talchir rocks, 84 square miles by the Barakars and 21 square miles by the Raniganj beds. The upper seams are of excellent quality. Total reserves amount to 9,966 million tons. A good part of the Jharia coal is of coking quality suitable for metallurgical purposes. Average quantity of coal raised per annum is about 10.5 million tons.

3. *Chandrapur Coalfield*. It lies at the extreme western end of the Jharia coalfield. It is only 400 acres in area and contains 9 seams of inferior quality coal.

### II. Hazaribagh District

4. *Bokaro Coalfield*. It lies two miles to the west of the Talchirs of the Chandrapur field. There are 19 seams over 4 feet in thickness. Reserves are estimated at 1,000 million tons of which half is of good quality coal.

5. *Ramgarh Coalfield*. This field lies 5 miles to the south of the Bokaro coalfield along the Damodar valley and is 40 square miles in area. Seams 36, 26 and 30 feet in thickness have been proved. These fields have not been surveyed in detail. Reserves are estimated as 5 million tons of coal in one square mile in area.

6. *South Karanpura*. It covers an area of 75 square miles. Production commenced in 1925. The Barakars of this field compare favourably with those of Jharia. Some of them are of unusual thickness, e. g., Argada seam 90 ft. Coal is of first grade and of coking quality. Reserves amount to 750 million tons. Mining is done by open quarries.



7. *North Karanpura*. This field has an area of 550 square miles. Representatives of Talchirs, Barakars, Raniganj beds as also Panchets and Mahadevas occur in this area. Coal seams occur both in the Barakars and in the Raniganj beds. Reserves were estimated at 8,750 million tons of coal. Some seams are of first quality and many of second quality.

8. *Chope Coalfield*. It is  $1\frac{1}{2}$  miles south of Chope and covers less than one square mile.

9. *Itkori Coalfield*. It lies  $3\frac{1}{2}$  miles to the west of Itkori. Reserves have been estimated at  $1\frac{1}{2}$  million tons.

10. *Giridih Coalfield*. The field has an area of 11 square miles to the south-west of Giridih of which 7 square miles are coal-bearing. There are three seams—Lower Karharbari, Upper Karharbari and the Bhaddoah seams. The Lower Karharbari seams vary between 10 ft. and 24 ft. in thickness and provide the finest coking coal in India for metallurgical purposes. In 1934 reserves were estimated at 49 million tons.

### III. Palamau District

11. *Auranga Coalfield*. It covers 100 square miles and is traversed by the Auranga river. Several coal seams occur, and some of them are 40 ft. in thickness. The field has been very much disturbed and the coal is worthless.

12. *Hutar Coalfield*. This field is 80 square miles in area. The coal seams occur in the Barakar rocks, but Talchirs and Mahadevas are also present. Two workable seams with 32 million tons of coal are considered to be the reserves.

13. *Daltonganj Coalfield*. It lies to the north of the Hutar coalfield. It covers an area of 200 square miles just to the north of Daltonganj. Most of the area is covered by Talchirs, and Barakars cover 32 square miles. Reserves amount to 9 million tons in an area of 13 square miles and the coal is of inferior quality.

### IV. Santal Parganas District

14. *Jainti Coalfield*. It has an area of 5 square miles and lies 6 miles south of Madhupur Railway station. Reserves are estimated to be 2 million tons.

15. *Sahajuri Coalfield*. This has an area of 12 square miles. The coal is of inferior quality, and reserves are estimated at 22 million tons.

16. *Kundit Kerai*. There are two thin seams of inferior coal.

### V. Brahmini River Coalfields (17-21)

These fields are situated at the western margin of the Rajmahal hills and are about 70 square miles in area. The coal seams are thin and of inferior quality. Reserves are estimated at about 210 million tons.

Sir Cyril Fox estimated the total reserves of coal in India in 1934 as follows :—

1. Total amount of coal as 25,950 million tons.
2. Restricting the totals to include only seams 4 ft. in thickness, 20 % ash and within 1,000 ft. of the surface, he estimated as 10,270 million tons.
3. Estimating for seams of good quality coal of upwards of 4 ft. and to a depth of 2,000 ft. with ash per cent 16 (moisture-free basis) as 4,672 million tons.
4. Reserves of coals which yield a hard metallurgical coke amount to 1,500 million tons.

No allowance has been made for losses in mining, perhaps only 30 % could be counted. In the coking coals extraction may be perhaps 50 % and at 4 million tons per year it may last for 200 years, but they are used for purposes other than metallurgical. If this practice is continued, the coal may be exhausted in 40 years, particularly the Jharia coalfield. This would be a great calamity, as India has vast resources of high-grade iron ore, which could not be smelted without adequate supplies of coking coal. The reservation of high quality coking coals for metallurgical purposes has become very urgent. There is also vast scope for the development of the by-product industries of coal.

India has to realise that her future industry depends on these resources and that it has a greater significance than the immediate profits of individual owners or zemindars, and every one connected with it should take a long view.

Other lines of action also remain to be taken, e. g., cleaning of high ash coking coals, improvement in the domestic fuel industry and the recovery of valuable by-products and utilisation of coal in the powdered state.

## 2. Iron-ore (Iron and Steel)

Bihar is the most important province for production of iron-ore in India. Indigenous iron-smelting industry flourished more in Bihar than any other province. Modern iron-smelting in India started with the ore in the iron stone deposits in the Gondwanas. Messrs. Tata Iron and Steel Co., Ltd. founded its industry on the iron ores discovered by late P. N. Bose of the Geological Survey of India, at Gurmahisani in Mayurbhanj state. The first operation started at Jamshedpur in 1911. Several subsidiary industries have started round it during the last 20-30 years. Rapid expansion of the iron industry followed in 1919 with the discovery of the vast hematite deposits in South Singhbhum. Since 1926-27 Tatas also utilised iron ores from Singhbhum for a large part of their requirements.

*Iron Ores of Kolhan, Singhbhum.* The investigation of this area was taken up by the Geological Survey of India in 1919, and several reports were published on

the work done by H. C. Jones, J. A. Dunn and others. A detailed account of the Noamundy mines has been written by Mr. Percival.

The iron-ores of Singhbhum occur in the rocks of the "Iron Ore series", which form steep forest-covered hills, the tops forming the remains of an old peneplain 2,000 ft. above sea-level. Higher ridges, consisting mainly of banded hematite-quartzite, rise to nearly 3,000 ft. in height. The origin of the massive ore has been due to enrichment of the banded hematite-quartzite. Irregular distribution of the ore is due mostly to irregularity in enrichment.

Practically the whole of the ore is hematite. Very little magnetite could be detected under the microscope. The ore consists of massive, soft and porous shaly ore.

*Reserves and Analysis.* Within the Kolhan estate and the adjacent Eastern States, the minimum estimate is about 3,000 million tons. The Kolhan ore contains up to 64% iron, rising in some cases even to 68-69%. Phosphorus ranges from 0.03-0.08 to 0.15%. The sulphur content is below 0.03%. The main features of the ore are high iron content, low sulphur and titanium and variable phosphorus.

Messrs. Tata Iron & Steel Co. and the Indian Iron and Steel Co. have iron ore mines in South Singhbhum. The Tatas have their mines at Noamundy, South Singhbhum and in Mayurbhanj and Keonjhar States. The Indian Iron & Steel Co. have their mines at Pansira Buru, Buda Buru and Gua in South Singhbhum. All their mines are connected by branch lines to the B. N. R. system.

The iron ores of Tatas are railed to Jamshedpur and those of Indian Iron and Steel Co. to Kulti near Asansol. The Tatas have 5 blast furnaces which could produce over a million tons of pig iron per year. Three-fourths of it are converted to steel.

The future of the iron and steel industry will depend on India's capacity to absorb the metal. The development of the post-war industries in India is sure to raise the consumption of iron in India. The scope for export may not be much, as some of her neighbours could manufacture their own requirements.

### 3. Mica

Bihar ranks as the premier mica-producing country for the whole world. The mica belt extends from the eastern part of Gaya, across Hazaribagh, Monghyr and Bhagalpur district—a stretch of country 90 miles long and 20 miles broad. 80% of the world's high quality sheet mica and 80% of the splittings used in making micanite come from this area.

The greater part of the Bihar produce used to be shipped to the United Kingdom, United States of America, Japan and Germany for use in the electrical industry. Since the commencement of the war, all the mica was purchased for the Government

and distributed between the United Kingdom and the United States of America for their electrical industry. Mica is an essential and invaluable insulator for all electrical machinery and apparatus and ranks as a strategic mineral. A Government mica mission was looking after production, purchase and export. Standards were fixed by them as regards quality, size and price, and all the mica was purchased accordingly.

The mica industry has been in existence for over 75 years, and since 1919 has expanded enormously. It engages about 150,000 people and is one of the largest and most valuable industries of Bihar.

*Uses.* There are different varieties of mica, but the Bihar mica is potash mica, known as muscovite. It can be split into minutely thin films along its cleavage. It is transparent, colourless in thin sheets, resilient and tough, chemically very stable and is a non-conductor of heat and electricity. Its remarkable insulating properties make it invaluable to the electrical industry. It is used for commutator insulation, transformers, electric heaters, rheostats, condensers, radio tubes, etc. The larger size of mica is also used for stove and furnace windows, lamp chimneys, etc.

Ground mica, made from waste, is also used in the manufacture of patent roofing, wall paper, filler in rubber goods, fancy paints, lubrication, etc.

Bihar mica is of various colours, such as green, white, brown, silver and ruby. Ruby mica is the most valuable and forms the major part of Bihar's production. Sheets of this mica even 1/8 inch thick have the ruby colour.

When mica from the mine has been cut and flaws removed, it is called 'block' mica. The percentage of block mica is about 20/25% for the belt. There are various qualities and sizes used in the trade and prices vary accordingly.

*Occurrence.* The mica occurs in pegmatite veins in the mica-schist and never occurs in the granite. Probably 25% of the Bihar mica comes from the surface workings, known as "Uparchalla" workings. The rest come from mines extending to various depths, down to 500 ft. from the surface.

Everything has not been well with the mica industry. The Government of India appointed the Mica Enquiry Committee for a detailed investigation of the different aspects of the industry-grading and marketing, conservation, research and utilisation, and to report on the desirability of setting up a suitable machinery, whether by appointment of a central mica committee or otherwise to watch the interests of mica trade and industry.

Mica has been a mineral of key importance with an assured export market. Before the war over 70% of the world's supply of muscovite mica came from India. India's mica exports increased both in volume and value during the war. In 1944, the value of mica exported was Rs. 2.75 crores. The labour employed in factories

and mines was 2½ lakhs. India's pre-eminence in the industry is as much due to rich deposits and cheap labour, whose superior skill and efficiency is not met with in any other country. The Indian mica-worker's reputation is so high that countries like Brazil, U. S. A., Canada send their mica to India for splitting.

In spite of all these advantages, the country has suffered from various defects of organisation. Methods of mining have been primitive and wasteful. Other evils are illicit dealings in mica, ill-paid labour and the system of working does not ensure a fair price to the honest producer. The organisation of the industry on sound lines is an urgent necessity.

So long as the electrical industry is progressing the Bihar mica industry has an assured future. The electrical industry serves man in ever increasing ways, and expands by leaps and bounds. As it is, the world's electrical industry is dependent on Bihar mica. Bihar holds the world's store of mica and has to conserve it with great care for India's future electrical industry.

#### 4. Copper

Copper-smelting in Chotanagpur was prevalent many centuries ago, but copper-smelting by modern methods has been very recent. The copper belt is about 80 miles long and extends from Singhbhum through Kharsawan and Seraikela State into Dhalbhum subdivision converging south east through Rakha and Mosaboni mines.

Several concerns started work in this area and had short careers, but the Indian Copper Corporation which started work in 1924 has been working all along. A rolling mill to make brass sheets was started in 1930. The corporation could produce 6,500 tons of refined and 8,000 tons of yellow metal per annum.

*Origin.* The copper ores of Singhbhum are related to tongues of granite which intrude into the schists. The ores occur as veins in the granite and in the schists and the enrichment follows a zone of overthrust, and form well-defined lodes in the Rakha mines and the Mosaboni and Doboni mines; the copper minerals are chalcopyrite, pyrrhotite with some pyrite, pentlandite, violarite and millerite. Gangue includes quartz, chlorite, biotite, tourmaline, magnetite and apatite.

*The Indian Copper Corporation.* The plants at the mine and works are operated electrically by power generated by the company. The ore is broken, handpicked to remove waste rocks, and again crushed to 3/8th inch. This crushed material is then taken on a belt conveyer to the rope-way bins, and then removed over an aerial ropeway 6 miles long to the concentration mill at Maubhandar. Here, after further grinding, the ore passes on to the froth flotation machines where 98% of the copper is recovered in concentrate carrying 24% copper. It is now dried and filtered,  $\frac{1}{3}$  roasted to remove silver, then mixed with  $\frac{2}{3}$  sulphide concentrate and then fired in

a reverberating furnace which gives a matte with 50% copper and a waste slag. The matte is treated in convertens where iron and sulphur are removed, leaving a blister copper, which is again refined. The whole of the refined copper is used to make brass or "yellow metal" by the addition of zinc. The yellow metal is converted into sheets and sold in India.

The Singhbhum copper belt has not been fully prospected. Further prospecting and mining may be possible, but it is not certain if there would be scope for another smelting works. Other occurrences are Baragunda near Giridih and Bairukhi in Santal Parganas.

## 5. Limestone

Limestone is one of the most essential raw materials and Bihar has a good supply. It is available at Rohtasgarh, Shahabad district in Lower Vindhyan formations, where the industry first started and has now spread to other districts. Cement works have been started in Shahabad and Hazaribagh districts. In view of the expansion of engineering and other industries the limestone industry has a bright future.

*Uses* : Its simplest use is as building stones, but it is not used in Bihar for this purpose. It is used largely for burning lime for mortar and plaster. The iron-smelting consumes much limestone as a flux, for which limestone outside the province is also used. Other uses are in the glass and chemical industries, e, g., bleaching powder, calcium carbide, etc. But the largest quantity is consumed in the manufacture of Portland cement.

The Vindhyan deposits are the only ones of large extent, although a number of deposits have been opened up in Bihar. In addition to the lime burning and cement industries, the possibility of carbide and calcium cyanamide have to be investigated..

## 6. Clays

There are several large deposits of clays in the province. The clay and fire-brick industries form a large industry in the province. Several kaolin deposits are also known and worked. The ceramic industry of Bihar is capable of great expansion.

The industry has grown up and used various types of clays. Four concerns manufacture refractory clay goods, and besides fire-clay is also exported to Bengal. Most of the China clay is exported for use in textile and paper industries.

The principal uses of clay in Bihar are in making village pottery, brick-making, cement, fire-bricks, ceramics, and as filler in the paper and textile industries.

## 7. Manganese Ore

Bihar produces only a small proportion of the manganese ore in India. The deposits are in Singhbhum, small and likely to be exhausted, but other deposits have been located in Keonjhar and Bonai States.

It is used mostly in the iron industry in making pig-iron and steel and also ferro-manganese. Manganese ores are also used in chemical industries as oxidising agents and making dry cells.

Most iron-ores contain manganese and there is every gradation from one to the other. The manganese ore in India is graded as follows:—

First-grade ore—over 48% Mn.

Second-grade ore—between 45 to 48% Mn.

Third-grade ore—below 45% Mn.

Chemical ores reach 58-59% Mn.

*Occurrence:* The manganese deposits occur both in the iron-ores and the Kolhan series. The ore consists of psilomelane and pyrolusite.

The manganese mining industry in Bihar has a limited future as the deposits are all very small.

## 8. Chromite

Chromite was discovered in Singhbhum by Mr. R. S. Saubolle in 1907 and the deposits have been worked continuously since 1909 by the Tata Iron and Steel Co., and the Singhbhum Chromite Co. No other workable deposits are known in Bihar.

It is the only available source of chromium for metallurgical and chemical purposes. It is used for making special steels as stainless steels, chrome steels and chromium plating. Singhbhum chromite has also been used for making chromite bricks, for refractory purposes and in making chromates.

Singhbhum chromite is graded according to  $\text{Cr}_2\text{O}_3$  content.

First-grade...above 47%  $\text{Cr}_2\text{O}_3$ .

Second-grade...44-47%. „

Third-grade...below 44%. „

Serpentine forms the impurity. It is associated with the ultrabasic igneous intrusions in the hills in Anjedbera and Sahedba Reserved Forests. The chromite deposits of Bihar, so far known, do not seem to have a long future.

## 9. Kyanite

Kyanite and allied minerals as andalusite and sillimanite all ( $\text{Al}_2\text{O}_3 \cdot \text{SiO}_2$ ) in composition have become important because of their use in the ceramic industries. For

ceramic and refractory purposes the minerals have to be first calcined to convert a portion of it into mullite. The kyanite especially expands on heating, which shatters the mineral and helps very much in crushing the rock.

Deposits of alumina silicates are not abundant and are restricted to a few countries. Kyanite deposits at Lapsa Buru on Kharsawan are the largest known in the world. The deposits were known since 1907, but their utility was known later and exploitation increased since then.

*Composition* :  $\text{SiO}_2$  36.8%,  $\text{Al}_2\text{O}_3$  63° 20%. Impurities of quartz, rutile, magnetite, mica and corundum are also present. It occurs as kyanite-quartz-granulite and aluminous mica-schists. It forms segregations and veins in these rocks.

*Uses* : Manufacture of refractory bricks and in ceramics. The known deposits are getting exhausted but further deposits may be discovered. All the kyanite is exported, except a small quantity used by Messrs. Burn & Co. to make refractory bricks. Perhaps some attempt could be made to manufacture the whole quantity into refractory bricks and ceramic-ware instead of exporting the raw mineral.

## 10. Steatite

Steatite or talcose stone minerals have been known from ancient time and have been utilised to make domestic utensils, etc. Accurate statistics are not available for them.

*Uses*: Modern applications consist of polishing medium, filler for making gas burners, small furnaces, stoves, etc. Steatite bricks are used in certain furnaces, Slabs are also cut for table tops, switch boards, and tanks.

The best occurrences are in Singhbhum and Manbhum and it is formed by the alteration of the Dalma lavas and ultra-basic igneous rocks.

There has been no organised industry as such for steatite, but there was a lot of enquiry for high quality talc during the war. There are large deposits of talc in Singhbhum and there is sufficient scope to develop a good industry.

## 11. Gold

Gold-washing has been and is prevalent in some of the rivers in Singhbhum and Manbhum. Auriferous veins are also present in a number of localities, but there are no rich deposits to start a mining concern with large capital. There may be scope for small prospectors and small syndicates.

Washing for alluvial gold may continue as an intermittent occupation of the villagers in certain localities.



## 12. Saltpetre

The salt occurs as a mixed efflorescence of sodium chloride, sodium sulphate, sodium carbonate and nitrate of potash and magnesia in the soils of North Bihar. The saltpetre content of the soil varies from 1.29% but the average is less than 5%. These nitrate earths are used as manure and also for the extraction of saltpetre.

The nitrate-bearing earth is known as 'Lona Matti'. Wood ashes are added to the Lona Matti to decompose any calcium nitrate that may be present, and the salts are dissolved in water. The liquor contains 15.25% sodium chloride, 7.24% potash nitrate, and the rest contains all quantities of chlorides and sulphates. On evaporation of the liquor, sodium chloride separates out first and the nitrate later. The crude saltpetre may contain 66% potash nitrate and 35% sodium chloride. The crude saltpetre is sometimes used as a fertiliser, but a good part of it is refined for making gunpowder, the by-product being soda sulphate. The saltpetre comes from Muzaffarpur, Saran, Champaran, and Darbhanga districts. Small amounts come from Shahabad, Gaya, Monghyr, and Patna districts.

The industry could be only of local interest and may be difficult to expand in view of competition from imported salts.

The above concludes the principal minerals of Bihar. Besides the above there are other minor industrial minerals which may contribute to the development of future industries.

### MINOR INDUSTRIAL MINERALS.

1. *Abrasives and Grinding Materials.* Diamond, corundum, emery and garnet are the principal minerals for abrasives. Garnet is the only mineral that occurs in Bihar in sufficient quantities to be used as an abrasive. Besides there are a number of minerals which are used for cutting, polishing, and burnishing as also milder abrasives for giving a finishing surface, e.g., pumice, volcanic dust, etc. Materials for such products are found in plenty in Bihar.

2. *Apatite Veins.* Apatite occurs as veins in Singhbhum and in the mica-belt. Phosphates are valuable for fertilisers. Apatite is a stable mineral and has to be converted into superphosphate by treating with sulphuric acid. There is considerable scope for research on the utilisation of the Singhbhum phosphate deposits not only for the fertiliser and the iron and steel industry, but other industries also that may require phosphates.

3. *Asbestos.* Asbestos occurrences have been noted in a few places in Manbhum and Dalbhum, Barabund and Manpur, Seraikela State near Chaibassa in the Kolhan Estate, in Mayurbhanj State and in Monghyr district.

USES: There are numerous uses, e.g., sheet packing, shingles, corrugated

sheetings, boiler plugs, electrical and heat insulators, filter and acid manufacturing plants, mill board, fire-proof cloth, tape, brake lining, asbestos rope, paper, etc.

4. *Barytes*. A few minor occurrences have been recorded in Bihar ; but they could never support a baryte industry. Its main uses are as filler of rubber, in the manufacture of white paint, lithophone, hydrogen peroxide, oxygen and Roentgen photography.

5. *Bauxite*. Good deposits of bauxite are present in Bihar, but they have not yet been utilised. Aluminium industry in India is still in its infancy. Bauxite has many uses in industry. It is the source of alumina and the Bihar material is really a high grade bauxite. But lack of cheap electric power and supplies of cryolite stood in the way of an aluminium industry in India. Bauxite could also be used to make refractory bricks, alumina abrasives, aluminium sulphates, etc. But the Indian bauxite has been used mainly for the purification of kerosine.

From 1943 onwards the whole of India's wartime requirements of alumina were supplied by aluminium reduction works of Travancore. Rolling mills and manufacturing plants were fully mobilised in the war effort and produced sheets and components for the manufacture of aircraft parts, radio, field telephone equipment, etc. Now construction is well advanced at Muri Junction, Bihar, for the treatment of Indian bauxite. These works are expected to go into operation by the end of this year. This work will use bauxite from the Ranchi district, Bihar, where modern mechanical mining and conveying of equipment will be installed at the bauxite mines. For technicians, men have been sent to Canada for training.

Bauxite, besides being the source of aluminium, has also other valuable uses, e.g., decoloriser of sugar, cane juice, jaggery and other hydrocarbons; decoloriser and desulphuriser of mineral oil; and quick-setting high alumina cement.

Bauxite is found in Ranchi and Palamau districts on the edges of scarps. The caps of the high plateaux in Chotanagpur are outliers of the Deccan Trap which represents a very old land surface. Owing to sub-aerial weathering the trap has been altered to laterite, a hydrated oxide of iron and alumina, the other constituents being leached out. Below this ferruginous laterite, aluminous laterite is also present, 8-24 ft. in thickness. The bauxite deposits of Bihar are likely to be valuable assets in the future, when bauxite industries could be started.

## 6. Building Materials

All kinds of building materials are plentiful in Bihar. A certain proportion is exported to Bengal. Granite, epidiorite, marble, rose quartz, slate, trap, etc. are available in several areas. In the Gangetic alluvium road metal is scarce and has to be got from long distances. The areas noted below have abundant supplies of the stones marked against them :—

- (1) Laterite—Santal Parganas, Chotanagpur.
- (2) Road metal—Rajmahal trap, Santal parganas, Quartz veins in Dharwars; Panchet sandstones.
- (3) Kankar—Coalfields and Santal Parganas.
- (4) Limestone—Sone valley near Rohtasgarh; Bisra, Sambalpur district, Panchet hill (Baghmara and Hamsapathar).
- (5) Sandstone—Vindhyan sandstone, Shahabad district, Talchir and Barakar sandstones of the coalfields; Panchet sandstones.
- (6) Slate—Kharakpur hills, Monghyr district, and Singhbhum district.

### 7. Glass-making Materials

Bihar is well situated for the supply of raw materials for the glass industry, but so far no industry on modern lines has sprung up. Perhaps the difficulty lies in lack of skilled labour and the competition with imported material.

The raw materials required consist of silica, sodium carbonate or soda ash or soda sulphate. Fusing them in the right proportion gives a soft and easily friable glass. Iron oxide forms an impurity and colouring agents are added to make coloured glasses. The sand used must have minimum of impurities which are harmful. Of these iron oxide should not exceed 0.02%. Above 1% the glass becomes dark green. Sand grains should be 0.04 mm. in diameter. River sand could be used when they are found of sufficient purity. Several sandstones near Rajmahal Hills, Talchirs and quartzite in the Archaeans and the Vindhyan could be crushed for glass sands, and also quartz veins of high purity. Sodium carbonate and sulphate are also obtained from the soil in Bihar.

Raw materials for making the commoner varieties of glass are plenty in Bihar, and there is considerable scope for research on raw materials and on methods of manufacture of glass.

### 8. Lead and Silver

Several small occurrences of lead and silver have been recorded in Bihar. They are only of scientific interest and there is no possibility of a lead-smelting industry in Bihar.

### 9. Mineral Fertilisers

The increasing importance of mineral fertiliser is now being felt in India. In 1944, a commission from England visited India for investigating the possibilities of the mineral fertiliser industry in this country.

Bihar has resources of the more important mineral fertilisers and is better off than other provinces. The fertilisers usually provide the soil with nitrogen, potash phosphorus, calcium, etc.

For nitrogen, sodium nitrate, potash nitrate, ammonium sulphate and calcium cyanamide are the sources. Bihar has potash nitrate; sulphate of ammonia is obtained from the coking plants in Bihar. Other sources for potash are potash felspar, blast furnace dust, and cement and kiln gases. Phosphorus is obtained from rock phosphate, apatite, bones, basic slag, etc. Apatite is obtained from Bihar. Phosphorus could also be made from bones by treatment with sulphuric acid as superphosphates, and for calcium limestone is abundant in Bihar.

### 10. Mineral Pigments

Mineral pigments are of three kinds :—(1) natural mineral pigments, (2) mineral sulphides treated for making pigments, (3) chemically manufactured inorganic pigments. The natural mineral pigments consist of yellow ochre, red ochre, red oxide which is soft ferric oxide with little or no clay base; umber and sienna-brown earth colours and ground slate or shale. Both yellow and red ochres are found in Bihar mainly associated with the basic igneous rocks and phyllites of the Archaeans. There is plenty of scope for a pigment industry in Bihar.

### 11. Mineral Springs

Bihar is most abundantly endowed with mineral springs, possessing medicinal and radio-active properties. They are Sitakund and Phillip's Kund in Monghyr district; Vishvamitra and Makhdumkund in Patna district. Some of them are held sacred and temples have been erected near by. Springs occur in the following areas in Bihar :—

1. Rajghir Hills.
2. Hazaribagh.
3. Monghyr.
4. Santal Parganas.
5. Coalfields.

Some of these waters are radio-active. The waters have to be used on the spot as the radium emanation is reduced to half in three days and completely lost in 30 days.

### 12. Refractory Materials

Bihar's mineral resources for refractory purposes are vast and varied. The materials consist of clays, silica, bauxite, chromite, fire-clays, dolomite, graphite, kyanite, quartz-schist, and steatite.

A large and important industry has been built up in Bihar and just over the border in Bengal using some of the province's material manufacturing refractory goods,

### 13. Sand

Sand is utilised in a number of industries for which no statistics are available. But the quantities used in building, road-making, stowing in coal mines and glass industry must run into many thousands of tons per year.

In Bihar stowing in coalfields will be the most important use. Any kind of sand could be used; the sand required may run to millions of tons to be taken from the Damodar River beds.

The sand resources of Bihar have to be examined in detail so that a fuller realisation of their utility could be had.

### 14. Sulphur

Resources of sulphur in India are deficient and India's requirements are met by import. Some iron pyrites has been found in the Shahabad district in the Vindhyan rocks which requires detailed prospecting.

### 15. Vanadium

It is found in the Mayurbhanj State and Singhbhum district associated with magnetite and illmenite. Its important use is in metallurgy. But such ores have not yet been used in metallurgy.

### Mineral Occurrences of Little or No Economic Value

There are a number of minerals occurring in Chotanagpur, which are of scientific interest, but are of no economic value. They consist of aluminium sulphate, antimony, arsenic, beryl, bismuth, columbite and tantalite, corundum, Fuller's earth, molybdenite, monazite, platinum, quartz crystals, tin ore, titanium, topaz, uranium minerals, wolfram and zinc.

For any detailed study of Bihar geology and minerals, the relevant publications of the Geological Survey of India may be consulted. Memoir, Vol. LXXVIII, "The Economic Geology and the Mineral Resources of Bihar Province" by J. A. Dunn is a recent publication, which was found very useful in the preparation of this paper. The author is also very grateful to the Director, Geological Survey of India, for kindly furnishing him with mineral statistics of Bihar and also the values of mineral production of India and Bihar for the years 1940-1944.

**Table I**

#### *Production of Principal Minerals in Bihar*

	Unit	1940	1941	1942	1943	1944
1. Asbestos	Tons	...	99	83	69	172
2. Chromite	"	3,521	4,967	5,917	3,939	4,541
3. Coal	"	15,344,992	15,822,388	15,917,281	13,582,927	14,363,892
4. Copper-ore	"	401,235	381,334	363,048	369,763	325,968

## GEOLOGY OF BIHAR

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		1940	1941	1942	1943	1944
5. Gold	Oz.	74.4	90.6	23	6	14
6. Iron-ore	Tons	1,655,338	1,800,584	1,773,114	1,328,909	940,875
7. Kyanite	"	119	64	...	...	...
8. Manganese-ore	"	32,452	53,308	21,157	15,316	4,495
9. Mica	Cwts.	34,270	1,28,955	1,21,774	1,03,468	1,00,298
10. Steatite	Tons	3,044	1,363	1,439	967	2,034
11. Limestone	"	6,54,620	7,91,658	7,23,224	6,82,976	6,70,739
12. Slate	"	511	1,960	920	479	365

Table II

*Total values of minerals produced in India and Bihar for 1940-1944*

Year	Bihar (Rs.)	India (Rs.)
1940	6,87,89,000	23,18,55,596—1940
1941	7,38,60,000	24,64,91,227—1941
1942	8,56,43,000	27,76,63,336—1942
1943	10,81,21,000	33,61,01,779—1943
1944	16,65,45,000	42,13,09,969—1944

## FLORA OF BIHAR.

*By*

Dr. P. K. Parija, M.A. (Cantab.), D.Sc. (Pat.)

The province of Bihar extends from Nepal on the north to the Orissa States on the south, and from Bengal on the east to the United Provinces, the Central Provinces on the west. The boundaries of the province of Bihar are only to a small extent natural, e. g., the crests of the Someshwar Hills on the Nepal frontier in lat.  $27^{\circ}30'$  bounding the area on the extreme north-west, the Ganges and its tributaries, the Gogra and Karmanasa, for a short distance on the west. The remaining boundaries are, in general, artificial. The total area is 1,11,829 square miles.

Haines divides the area into two main tracts which are more or less natural. These are :—

- (1) the northern tract, mostly plain, and
- (2) the southern tract, the highland which forms a main water-parting.

The northern tract consists chiefly of the great alluvial plain of the Ganges. It is bounded on the north by the foot-hills of the Himalayas which are geologically and floristically different from the main tract. In the south of the northern tract, there are hills, such as the Rajgir Hills which are really outlying spurs of the central highland from which they are separated by alluvium.

The central tract consists mainly of a region of plateaux and mountainous spurs which are the outward termination of the huge Satpura-Vindhyan Massiv which radiates from Amarkantak in Central Provinces, 3,493 ft. above sea level. This elevated main central tract has a trend somewhat north of east, and is mostly over 1,000 ft. in elevation. It ends in the Rajmahal Hills.

Towards the edges of the plateaux are ranges of hills or mountains, sometimes of considerable height, and the scarps usually fall away in rugged spurs and hills cut up by ravines and rivers.

Parasnath, the highest mountain in the province, is situated in one of the spurs of the central plateau.

The southern is not sharply demarcated from Orissa and Orissa States in the south. The large rivers of the Burabalang, Baitarani and Brahmani originate in the southern tract and run down through Orissa States and Orissa to the Bay of Bengal.

In a province like Bihar, extending over more than  $8^{\circ}$  of latitude, it is natural to expect great diversity in the nature of the soil, rainfall, humidity and temperature. Thus, for example, the rainfall in the northern area increases from west to east, from 44.4 inches in Saran to 67.9 inches in Purnea. The same is true for the central area :from 44.9 inches in Palamau to 54.1 inches in Santal Parganas.

The seasonal variations are naturally great. In the northern tract the winter is fairly severe, the minimum being about  $35^{\circ}\text{F.}$ , while the greatest range of temperature variation for the northern and southern tracts is about  $55^{\circ}\text{F.}$

Apart from the temperature variations due to the extension of the province over several degrees of latitude, there is a good deal of variation due to altitude.

Due to climatic and edaphic variations the province of Bihar cannot constitute a true botanical province. In fact, in Bihar are included portions of three botanical provinces of Hooker and Thomson, viz.

- (1) the lower part of the province of the Upper Gangetic plain,
- (2) a small part (Purnea) of Bengal, and
- (3) the whole of the province of 'Bihar', which practically corresponds to the southern tract referred to above.

Still Bihar has certain botanical features worth notice. This province as a whole is characterised, according to Haines, by the complete absence of Cupuliferae, a general scarcity of laurels and myrtles, and by few Ranunculaceae, Magnoliaceae, Cruciferae, Guttiferae, Rosaceae, Umbelliferae, and comparatively few Orchidaceae. On the other hand, it possesses marked positive features in the presence, practically throughout, of the Sal tree (*Shorea robusta*), and in the almost general association with the Sal a large number of individuals, if not of species, of *Terminalia*, *Anogeissus*, *Bassia*, *Butea*, *Schleichera*, *Gardenia*, *Wendlandia*, *Acanthaceae*, *Bauhinia*, *Diospyros*, *Zizyphus*, *Cleistanthus*, *Nyctanthes*, and except in the Gangetic plain, of the bamboo and of the grasses, the Sabai grass (*Ischaemum angustifolium*) and the spear grass (*Heteropogon contortus*). The Anonaceae are also well represented.

The general character of the vegetation is tropophilous. Towards the beginning or middle of the hot season the forests are practically leafless, but in most of the deciduous trees new leaves are put forth well before the monsoon. Woody species flower most in the hot season. On the other hand, a large number of herbs or suffruticose species flower in the cold season. In the beginning of the monsoon a quantity of bulbous and rhizomatous Liliaceae, Amaryllidaceae, Scitamineae, etc., send up their scapes and flowers.

The monsoon period is further characterised by the rapid production of the aerial shoots of a number of suffruticose or herbaceous climbers such as *Dioscorea*,



Asparagus, Smilax and Ipomoea, and by the general production of shoots and leaves of evergreen and deciduous trees and shrubs, and by the growth of innumerable annuals which flower during the rains or after their cessation.

The dominant families, according to Haines, as indicated by the mere number of species, are in the following order.

1. Leguminosae, 2. Gramineae, 3. Cyperaceae, 4. Compositae,
5. Euphorbiaceae, 6. Acanthaceae, 7. Rubiaceae, 8. Labiatae,
9. Scrophulariaceae, 10. Convolvulaceae, 11. Urticaceae, 12. Verbenaceae.

In the matter of distribution of species the factors noted above, viz., temperature, precipitation, humidity, elevation and soil character, play an important role. In addition to these, the human influence must have played, and is playing a very important part, more important than the factors mentioned. The destruction of forests resulting in desiccation and erosion of land surface is attributable to man, while man is responsible for the introduction of cultivated plants for his own benefit. Here his activities are to a great extent checked by climatic conditions. Thus, for example, wheat cultivation is confined to drier and colder regions.

Apart from the conscious efforts, as exemplified in the case of cultivated plants, man is unconsciously responsible for the introduction of a number of weeds. The water hyacinth is a case in point. This American weed has spread so rapidly that it has become a pest in the province. Similarly, *Croton sparsiflorus*, a native of America, now forms very dense formations in the river banks and waste places. Such examples could be multiplied at length.

Now coming to the characteristic features of the regional vegetation of the two constituent tracts, it is to be noted that the northern tract contains the great Gangetic plain. This plain has practically no natural formations. Most of the plain is cultivated and the cultivated plants vary according to season and elevation of land. The distinctive character of the wild flora of the higher cultivated lands is the presence of many European genera and is due to the marked cold season and the direct seeding from the Himalayas. *Fragaria*, *Potentilla* and *Veronica* may be mentioned as examples.

On the river banks Khair-Sissu formations often extend over many square miles. The Someshwar Hills have a flora which is essentially lower Himalayan. In this very brief account only a few species may be given in illustration, such as *Pinus longifolia*, *Cycas pectinata*, *Sterculia fallens*, *Grewia helicterifolia*, *Rhus semialata*, *Moringa oleifera* and *Piper peepuloides*.

Fresh water formations are remarkably uniform throughout the province. Of the Nymphaeaceae, *Euryale forox* is supposed to be confined to the northern tract.

Some species peculiar to the northern tract, according to Haines, besides those mentioned in connection with Someshwar Hills, are *Eriolaena Wallichii*, *Lepidodermis macrostyla*, *Rubus ellipticus*, *Gymnosporia*, *Sabia paniculata*, *Albizzia lucida*, *Ficus Glaberrima*, *Bassia butyracea*, *Stephania hernandifolia*.

Coming to the southern tract, it contains a considerable area of natural forest. The flora is essentially tropophilous but with a tendency towards xeromorphic structure in many of its species. Even the Sal shows xerophytic tendencies. There are many trees with a thin translucent bark letting in light to the underlying chlorophyll. Such trees, e. g., *Sterculia urens*, *Odina Wodier* and *Cochlospermum gossypium* can carry on without leaves for several months at a stretch.

Among the xerophytes Euphorbiaceae, Apocynaceae and Asclepiadaceae are prominent.

The greater part of the forest area is occupied by the Sal formations. With the Sal are associated in the valleys *Terminalia tomentosa* and *T. belerica*, *Schleichera trijuga* and *Pterocarpus marsupium*, while on the hills *Gardenia* spp. and *Dillenia aurea*, *Terminalia Chebula*, *Anogeissus latifolia* are the associates.

Besides the Sal formations, we have the *Terminalia* formation, Khair (*Acacia Catechu*) formations and the evergreen forest dominated by *Diospyros*, *Garcinia*, *Saraca*, *Amoora*, &c.

The predominant species of the inextensive grass lands is *Heteropogon contortus*.

The mountains of the Southern tract possess many elements of a more temperate flora which occur either on the lower Himalayas or in the mountains of Madras or both, and a few which appear endemic although closely allied to species either Himalayan or Deccan.

# LABOUR PROBLEMS AND WELFARE ASPECTS WITH REFERENCE TO CONDITIONS IN BIHAR

*By*

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*Deputy Commissioner of Labour, Bihar.*

The province of Bihar is very rich in mineral and agricultural resources. The mineral wealth is mainly confined to the Chotanagpur Division, while North and South Bihar are rich in agricultural wealth. Bihar has a practical monopoly of mica, shellac and copper and is the most important producer of coal and iron ore, while her output of cement, sugar, cigarettes, etc. is not negligible. The richness of her resources is evidenced by the variety of her industries. Thus, we have coal mines, railway workshops, metallurgical and engineering industries, cement, glass, ceramics, cotton, jute, paper, match, tobacco, sugar, oil and rice, boot and shoe factories scattered throughout the province. The number of registered factories which actually worked during 1946 was 476, of which 67 were seasonal factories. The average daily number of workers employed in these factories during 1946 was 1,39,000 of whom about 23,000 were employed in seasonal factories, mainly sugar. Of the total number employed 1,27,000 were adult males, 11,000 adult females and 1,100 adolescents and children. Female workers were mainly employed in mineral and metal industries. Classified by the number of persons employed, we have 142 factories employing 20 to 50 workers; 62 factories employing 50 to 100 workers; 65 employing 100 to 500 workers; 22 employing 500 to 1,000 workers; 17 factories employing 1,000 to 5,000 workers and 2 employing more than 5,000 workers. The three districts employing the largest number of factory workers are Singhbhum (47,000), Manbhum (18,000) and Monghyr (16,000). The most important centres of industry in the province are Jamshedpur, where the metallurgical and engineering industries, including the firm of Tata Iron & Steel Co., are located; Monghyr, with the important workshop of the E. I. Railway and the Tobacco factory of the Tobacco Manufacturers (India) Ltd.; Dalmianagar, with its 7 or 8 factories owned by the Rohtas Industries Ltd., and Katihar with its two jute mills, match factory and oil mills. The Government of Bihar, unlike the Governments of Madras, Bombay, C. P. and other provinces have hardly utilised the provisions of section 5 (1) of the Factories Act under which provincial Governments have been given power of bringing factories employing 10 or more workers within the scope of the Factories Act. We have only 8 such notified factories in Bihar. Attempt is now being made to apply the provisions of the Factories Act and the Payment of Wages Act to the shellac factories, mainly situated in the district of Manbhum, and the mica

factories, mainly situated within the district of Hazaribagh, employing 20 or more workers but not using power. The number of unregulated establishments is pretty large and it was estimated that in 1937 there were about 436 of such establishments employing about 22,000 workers. The mines in Bihar registered under the Indian Mines Act employed about 2,08,000 persons in 1943, the important minerals produced being coal, mica, iron, limestone, china-clay and copper.

Bihar is still predominantly agricultural in spite of her 550 registered factories and 1250 (of which 415 are coal mines and 710 mica mines) registered mines; and her industrial labour has not yet severed its link with agriculture. This is apparent from the very pronounced absenteeism of industrial labour from which the factories suffer during the sowing and harvesting seasons. Bihar, however, has her industrial problems, and with the advent of the popular ministry, there was a large increase in the number of strikes during 1937-39. This led to the setting up of the Bihar Labour Enquiry Committee in 1938 and the appointment of a Labour Commissioner in 1939 on an experimental basis with headquarters at Jamshedpur. The headquarters of the Labour Commissioner were transferred after a couple of years to Patna and the Labour Office under a Labour Commissioner was put on a permanent footing in 1944. At present the Labour Commissioner is helped by a Deputy Labour Commissioner, two Assistant Commissioners of Labour and two Labour Officers. The Labour Commissioner is also the Registrar of Trade Unions and his main duty, as also that of the officers under him, is conciliation of industrial disputes under the Industrial Disputes Act. It should, however, be noted that railways and mines are outside his jurisdiction; and industrial disputes in these undertakings are looked after by the Government of India who have a small staff stationed within the province for the purpose. The Factory and Boiler Inspection Departments have been placed under the administrative control of the Labour Commissioner, Bihar. Bihar, unlike the more advanced industrial provinces such as Bombay and U. P., has been relying almost entirely on Central legislation for safeguarding the interest of labour, and the only piece of provincial legislation so far passed in Bihar is the Bihar Maternity Benefit Act, which was enacted in 1945.

During the last war there was an increase in the volume of employment and a rise of wages. Thus, employment in registered factories rose from 93,000 in 1938 to 1,69,000 in 1945 and in registered mines from 1,70,000 in 1938 to 2,08,000 in 1943. The average daily wages of a fitter, carpenter and male coolie rose from 1/4/-, 1/2/- and -/6/- respectively in 1935 to 4/-, 2/4/9 and -/13/- respectively in 1946. Similarly, the average daily earnings of underground miners and female coolies rose from -/8/- and -/5/3 respectively in 1934 to -/13/9 and -/11/- respectively in 1943. With the advent of the popular ministry in April 1946 and the relaxation of war-time restrictions, there was a rapid and alarming increase

in labour unrest and it seems that we have not yet passed through the peak period. In 1946 there were more than 80 strikes or cessations of work, not to speak of the many more labour disputes which were settled amicably without leading to cessation of work. Twenty disputes were referred for adjudication under the D. I. Rules in 1946. By a series of strikes and threats of strikes, adjudication awards and voluntary agreements, the wages of labour have been raised approximately to three to four times the pre-war level; or, in other words, labour has been, on the whole, able to hold its own against the rise in the cost of living.

The main labour problem in the province of Bihar just now is the settlement of trade disputes and the formation of trade unions. Since the cessation of the war and the advent of the popular Government at the centre and in the provinces, a large number of trade unions has been set up by the different political parties in the important industrial undertakings, municipalities, district boards, etc. As soon as trade unions are formed they formulate sets of demands and grievances on behalf of the workers of particular undertakings and place them before the employers for their fulfilment. In most cases demands are followed up by threats of strikes. In some cases workers resort to strikes even without notice. Very recently a tendency has been developing among the workers of going on hunger strike instead of general strike. As soon as demands framed by workers are brought to the notice of the Labour Commissioner and his staff, immediate steps are taken to bring the representatives of workers and their employers together at a meeting to discuss the demands with a view to bringing about a settlement. Those disputes in which conciliation fails are referred for adjudication under the Industrial Disputes Act, 1947. The Industrial Disputes Act provides for 14 days notice of strike only in the case of public utility services. It seems desirable that strike notice should be given by workers in all industrial undertakings before going on strike, as recommended by the Bihar Labour Enquiry Committee and as was provided for by the D. I. Rules. The notice period affords an opportunity to conciliation officers to bring about a settlement. In many cases threatened strikes are warded off by the timely intervention of Conciliation Officers. The labour unrest is at its highest at the present moment. An important cause of the aggravation of industrial disputes is the fight for leadership among trade union leaders belonging to rival political parties. There is a race for getting control of the leadership of the labour in all parts of the province. Katihar, in the district of Purnea, and the Jharia Coalfields have become hotbeds of labour unrest partly due to this fact. It is desirable in the interest of labour that there should be one well-organised labour union in a factory instead of several unions each trying to enlist the support of labour by securing concessions from employers. The Government of India are proposing to find a remedy for the multiplicity of unions in the same establishment by an amendment of the Indian Trade Unions Act providing for the recognition of only one union by the management of an industrial establishment.

The assumption of office by the popular ministry gave a great impetus to the formation of trade unions. There were only 50 trade unions registered under the Trade Unions Act before the Congress Ministry assumed office. More than 100 new unions have been registered since 1st April 1946 and about 50 applications for registration are under examination and scrutiny. There is also a large number of labour unions which have not yet applied for registration. The membership of 51 registered trade unions which have submitted their annual returns to the Registrar of Trade Unions for the year 1946-47 is 35,585. 60 unions have not submitted their annual returns and therefore the membership of these unions cannot be given. 42 unions are newly registered and are not required to submit annual returns for 1946-47 and therefore their membership is also not known. An enquiry was made in April 1946 about the affiliation of the unions to the All-India organisations of workers. It was found that out of 55 registered trade unions which responded to the enquiry, 11 were affiliated to the All-India Trade Union Congress and 7 were affiliated to the Indian Federation of Labour and the rest were not affiliated to any organisation. The influence of the Indian Federation of Labour in the trade union field has further waned and is now practically non-existent. The two most important political parties working in the trade union field today are the Socialists (S. P. I) and the Communists (C. P. I) which between them cover about three-fourths of the whole field. Statistics are lacking to give a clear picture of the number and membership of unions affiliated to each political party. But the Socialists seem to have captured the largest number of unions, Communists coming up second. As long as Prof. Bari was alive, his influence in the labour field was unique and Congress unions under his leadership, if not the most numerous, were the most influential in the province. Since his death the Socialists and Communists have been trying to capture these unions. The Forward Block control a couple of unions in this province but their influence is negligible.

Trade Unions in Bihar can hardly be said to have yet acquired stability and permanence. Even the few unions which have been functioning for a decade or two have hardly done any constructive work such as payment of sickness benefit, running of night schools, fighting of workmens' compensation, cases on behalf of its members in law courts, establishment of co-operative stores or credit societies for the benefit of members, etc. Their activities are mainly confined to fighting for an increase of wage, dearness allowance or bonus and resisting attempts at dismissal, discharge and retrenchment of workers. Unions are very keen on their being recognised by the employers and even new unions, which have not yet been registered as trade unions, are prepared to make the recognition of the union by the management a strike issue. Employers in Bihar even now fight shy of trade unions and are not above victimising trade union workers in order to break the union. Occasionally they set up rival trade unions fostered by them to counter the influence of independent unions. Employers have been complaining

of late that efficiency of labour has been going down and discipline in the factory has been undermined as a result of trade union leaders acting in an irresponsible manner. The passage of a Central Act providing for recognition of trade unions may yet take some time and it seems desirable that the activities of trade unions should be turned into profitable channels by providing for recognition of such unions as satisfy certain conditions such as :—

- (a) a minimum period of existence as a registered trade union;
- (b) a minimum percentage of membership of the workers working in the establishment;
- (c) a minimum rate of subscription regularly collected;
- (d) audit of accounts by an auditor appointed by Government;
- (e) provision in the rules of the union not to take part in illegal strikes or in strikes which have not been approved by a ballot of the members;
- (f) strict observance of the rules of its constitution.

The Government of Bihar have not yet started Welfare Centres for industrial labour as has been done in United Provinces, Bengal and Bombay. But attempts have been made by Government to persuade employers to provide welfare services for labour as far as possible. All employers employing 750 workers and above have engaged full time medical officers and established dispensaries for the treatment of workers and their families. Canteens for the supply of cheap and wholesome food (or refreshment) for the workers have been started by all the firms at Jamshedpur, though there is still considerable scope for its extension in the other parts of the province and is being held back mainly by the difficulty of procuring supplies of food materials. The provision of creche has now been made compulsory under the Factories Act and the Bihar Maternity Benefit Act in factories which employ a minimum number of women workers. Housing is engaging the careful attention of Government and a Special Officer has been appointed to draw up a scheme of industrial housing. But the main difficulty here is the scarcity of building materials and their high prices. Schemes of provident fund and retiring gratuity are being increasingly demanded by labour and conceded by employers. A Workers State Insurance Bill to provide for sickness, maternity and employment injury has been introduced in the Central Legislature and, when passed into law, will provide a much needed element of social security for industrial workers. A bill for the fixation of minimum wage is also before the Central Legislature and it is hoped that at no distant date it will be placed on the statute book. There are considerable difficulties in the way of unemployment insurance in this country and it may yet take some time to achieve some tangible result in this direction.

The condition of colliery labour clamoured for improvement before the War. During war-time owing to the urgent necessity for increasing the output of coal

and to dissuade colliery labour from migrating to other fields of employment where better wages and conditions of work prevailed, considerable attention was paid to improving the wages and conditions of work in the collieries. The Government of India instituted a Coal Mines Labour Welfare Fund, financed out of a cess levied on the dispatch of coal, for the provision of houses, hospitals and other amenities to colliery labour. Further, as a result of the recommendations of the Board of Conciliation appointed by the Government of India, very considerable increases in wages, dearness allowance, bonus, overtime pay, etc. were granted to colliery labour in May 1947. The Jharia Mines Board of Health and the Jharia Water Board have also been looking after the housing and health of the mining population of the Jharia coalfield since 1920. A Mica Mines Welfare Fund has also been recently instituted, financed by a levy on the export of mica, but it has hardly begun to function yet.

Four Employment Exchanges have been set up in Bihar at Patna, Jamshedpur, Dhanbad and Muzaffarpur. These are at present run by the Government of India and concern themselves mainly with the resettlement of discharged war workers. But it is probable that these Exchanges will in course of time be taken over by the Provincial Government and their scope extended to cover all categories of workers. Besides the Employment Exchanges, the Employment Bureau functioning under the Commissioner of Labour, caters to the needs of the unemployed literate workers.

In order to associate more closely the employees and workers with the work of labour legislation and labour administration a Central Labour Advisory Board has been recently set up on a tripartite basis.

The present labour situation in the province calls for certain remedial measures.

- (1) An immediate expansion of the Labour Department with a research and publicity section attached to it.
- (2) Legislative provision for recognition of trade unions, provided they conform to certain conditions. As an incentive to the acceptance of these conditions, certain privileges such as collection of trade union subscriptions at the pay office, representation on the Works Committee, right of access to the management to represent grievances and demands, etc. may be granted.
- (3) A clear definition of what constitutes unfair labour practice on the part of employers and acts of indiscipline and intimidation on the part of workers and a rigorous and prompt enforcement of the obligations on either side.



- (4) The immediate enforcement of the Industrial Establishment (Standing Orders) Act which still remains inoperative as rules under the Act have not yet been framed by the Provincial Government.
- (5) No strikes to be permitted without 14 days notice being given to the employer and the Conciliation Officer. The definition of strike to be expanded as in the Sind Industrial Relations Bill, 1947 to include slow-down strikes as well.
- (6) Besides the Industrial Court which in this province is not a standing body but is set up *ad hoc* for the adjudication of each industrial dispute as it arises, there should be some decentralised organisation such as the District Industrial Court provided for in the C. P. and Berar Industrial Disputes Settlement Act, 1947 for promptly settling minor industrial disputes such as cases of alleged victimisation or factory indiscipline. In the alternative, statutory powers may be given to the Labour Commissioner to decide these cases.

Then there is the question of a large number of workers employed in shops in Bihar. The only Act to safeguard their interest is the Weekly Holidays Act, 1942. This is a Central Act and provides only for weekly holidays for the shop assistants. In almost all the other provinces of India legislation prescribing holidays, hours of work, security of service, minimum age of employment, etc. of the shop assistants has been passed. Government of India are also contemplating to enact further legislation on this subject, but it is not known when this will materialise. Therefore, it seems desirable that in Bihar too legislation on the lines of those prevailing in other provinces should be passed.

# THE TATA IRON AND STEEL WORKS

## Early History

The art of smelting and shaping iron has been practised in India from very early times and a regular trade with Europe and Middle Eastern countries is known to have been in progress. The famous iron pillar of Asoka, erected some 2,000 years ago, stands as a significant testimony to the craftsmanship of the early workers. India supplied the material from which the renowned Damascus steel blades were made. The methods adopted by the artisans were, however, primitive and laborious. The aborigines of Central India and other neighbouring districts, where high-purity iron ores occur in abundance, were smelting the relatively soft manganeseiferous ores in small mud furnaces, with the aid of wooden bellows for the supply of the necessary blast to reduce the metal. This primitive art, however, has almost faded out by the onslaught of the developments made in western countries and the rapid industrialisation that has taken place.

The manufacture of iron and steel on a commercial scale was attempted in this country in the early eighties. One Mr. Heath, a retired Madras civilian, attempted to establish a works for the reduction of the iron ores at Porto Novo with the help of the grant given by the East India Company, but with the death of Mr. Heath and a number of successive impediments that could not be overcome, the attempt was given up. The next commercial enterprise was the establishment of Barakar Iron Works in the Jharia coalfields in 1875, but this too did not succeed. The Government however re-started the operations in about 1897 and handed it over to the Bengal Iron Company situated at Kulti in Western Bengal. The Bengal Iron Company have been working since then. The third and most outstanding enterprise was that of Mr. Jamshedji Nusservanji Tata. Though Mr. Tata had been striving hard to establish an iron and steel industry since 1900, the culmination of his project in the formation of the Tata Iron and Steel Company took place in 1907. It was due to the indefatigable perseverance, zeal, foresight and pioneering efforts of Mr. Tata that after surmounting considerable opposition and discouragement he eventually succeeded in translating his great dream to practical form. Mr. Tata with his Indian associates and the very valuable technical advice rendered by the American engineers, succeeded in establishing the works at Sakchi, in the year 1908. The original recommendation made was for construction of the plant at Sini, a station on the Bengal Nagpur line in the Singbhum district, but, as adequate facilities for the perennial supply of water at economical cost could not be obtained at Sini, a site near Kalimati station, now known as Tatanagar, 18 miles east of Sini junction, was selected eventually in 1908. The actual commencement of the construction of the works

started in 1908. The first pig iron was made in 1911 and the first steel ingot in 1912. Here was initiated the most potent undertaking which was destined to play a very important role in the industrial development of India. What was once a small village of 'Sakchi' had grown into the foremost industrial city of India and was aptly renamed 'Jamshedpur' after the name of the founder.

Tatanagar, which is the Railway station on the B. N. Rly. Bombay-Calcutta main line, is about 150 miles west of Calcutta. The works site covering an area of about  $2\frac{1}{2}$  sq. miles is bounded on the north by the Subarnarekha river and on the west by the Kharkai river, and the modern town with a population of about 1.75 lakhs occupies an area of approx. 25 sq. miles. The site chosen for establishing this great works has the unique advantage of being in close proximity to the sources of essential raw materials and the important markets. The iron ore mines are situated within a range of about 40-80 miles, while the coalfields are some 115 miles away. Calcutta, which is the main port, is 156 miles distant.

### Raw Materials

The important raw materials for the iron and steel industry are :—Iron ore, Coal, Limestone, Dolomite, Manganese ore, Refractory materials, and a number of other minor products.

### Iron Ore

The Tata Iron and Steel Company draws its requirements of iron ore from the vast iron ore deposits in the Singhbhum district and the neighbouring states of Mayurbhanj and Keonjhar. The ore is principally Hematite, containing on an average about 60 per cent iron, obtained from the following sources :

- (a) Gorumahisani mine.
- (b) Badampahar mine.
- (c) Sulaipat mine.
- (d) Noamundi mine.

In the Singhbhum district and neighbouring states, iron ore is generally found on the top and along the slopes of hills, either 'in situ' or as 'float ore'. Solid ore beds are found mostly on the hill tops and 'float ore' on the slopes and valleys. The mining of the ores—more correctly, "open cast quarrying"—consists of digging the ore by crowbars in float ore and by resorting to hand drilling and blasting in solid ore. The ore from the mine face is loaded into mine tubs and hauled to the crusher chute by steam locos. After the ore is broken in the crusher, it flows into Hopper wagons to be conveyed to the works at Jamshedpur. The transshipment of the ore from the mining face to the main loading point, though generally assumed to be a simple matter, is in

actual practice rather complicated and forms a well-integrated system comprising manual labour and mechanical modes of haulage. Extensive use of gravity-operated inclines is common. The ores as obtained from the mines contain, particularly in the monsoon months, an admixture of deleterious substances such as earthy matter and 'moorum'. A 'washing plant' to remove these impurities is under erection at Noamundi mine.

The occurrence of iron ore in Mayurbhanj was first discovered by Mr. P. N. Bose, who made a brief mention of it in the reports of the Geological Survey of India. Subsequently, the possibility of these ores being utilised for the manufacture of iron and steel was examined by the Tata Iron and Steel Company, who undertook detailed prospecting of the ore deposits in the concessions granted by the State. A thorough and extensive prospecting of the ore deposits brought into light the existence of a good amount of high-grade ore in the more accessible parts of the state. Of these deposits Gorumahisani, Okampad (Sulaipat) and Badampahar are the most prominent.

The following are the average analyses of iron ores from the Tata Iron mines for the year 1945-46 :

	Fe. %	Silica. %	Alumina. %	Phos. %
Noamundi—				
No. 1 grade	59.76	3.23	6.22	.115
No. 2 grade	66.66	1.08	2.17	.065
Gorumahisani—				
No. 1 grade	61.78	3.26	2.79	.07
Badampahar—				
No. 3 grade	55.60	7.39	2.88	.075
Sulaipat—	68.55	1.25	—	.015

### Gorumahisani Mine

The Gorumahisani hill with its three prominent peaks, the highest rising to 3,000 ft. above sea level, and with its enormous flanks, forms a conspicuous feature in the topography of the northern part of the Mayurbhanj state. The reserves of the Gorumahisani deposits were first stated to be at least 9,800,000 tons of ore.

Since 1914-15, over 13 million tons have been extracted and new deposits of ore have since been discovered. A survey carried out in 1942 has raised the estimate of the reserves to about 20 million tons. The bulk of the ore mined at Gorumahisani mines up to 1928 was 'float' ore. Since then 'in situ' deposits have been mined. The average iron content in the ore from Gorumahisani at the present time is about 63 per cent.

### **Sulaipat Mine**

The Sulaipat deposits are situated west of the Kharkai river where the latter breaks through the Sulaipat-Badampahar range, 12 miles south of Gorumahisani. Sulaipat ore is very rich and the approximate analysis of the grade used for Open Hearth steel melting has given over 68 per cent Fe. (true) content. Since the mine has been developed, further ore bodies have been found and, up to the end of March 1944, something like 2,817,000 tons have been despatched. The deposits then remaining were estimated at 1,200,000 tons.

### **Badampahar Mine**

The Badampahar range lies  $8\frac{1}{2}$  miles south-west from the Sulaipat ore body. The total amount of ore at Badampahar was estimated in 1944 to be 32 million tons. Unlike the rich lustrous ores of Sulaipat and Noamundi, much of the Badampahar ore has a peculiar yellowish colour and is relatively very light in weight. It is generally more porous than either the Gorumahisani or Sulaipat ores and though the average ore has an iron content of about 54 per cent only, which is much lower than the other two deposits, it has been found useful on account of its porosity and its suitability to form a well-balanced blend.

### **Noamundi Mine**

The Noamundi ore deposits are situated in the Kolhan Government estate in the Singhbhum district, extending southwards into Keonjhar state. They were discovered in 1917. The ore occurs as thick beds of hematite averaging over 60 per cent iron with very considerable quantities of hard ore containing 67 to 69 per cent iron that can be separately mined and despatched. The deposits run along two main parallel ridges and the ore at the surface is either hard, massive or laminated. In the latter case, it is often soft and shaly in appearance. The mine is connected with a broad gauge railway siding and a part of the ore is sent by aerial ropeway from the mines to the loading station. The average analysis of the ore obtained so far is roughly 60 per cent iron, 4 per cent silica and 5 per cent alumina. Experiments to 'wash' the ore to eliminate the alumina and silica from the ore having proved successful, a pilot washing plant has been established to yield a richer ore and a full-scale plant is now being erected. The establishment of a 'sintering' plant to sinter the powdery ores is also under active consideration. Noamundi is presumed to be the biggest iron mine in Asia.

### **Coal**

Next to iron ore, the essential raw material required for the production of iron is coking coal. The Tata Iron and Steel Company owns five collieries in the Jharia coalfields about 117 miles from Jamshedpur, which supply about



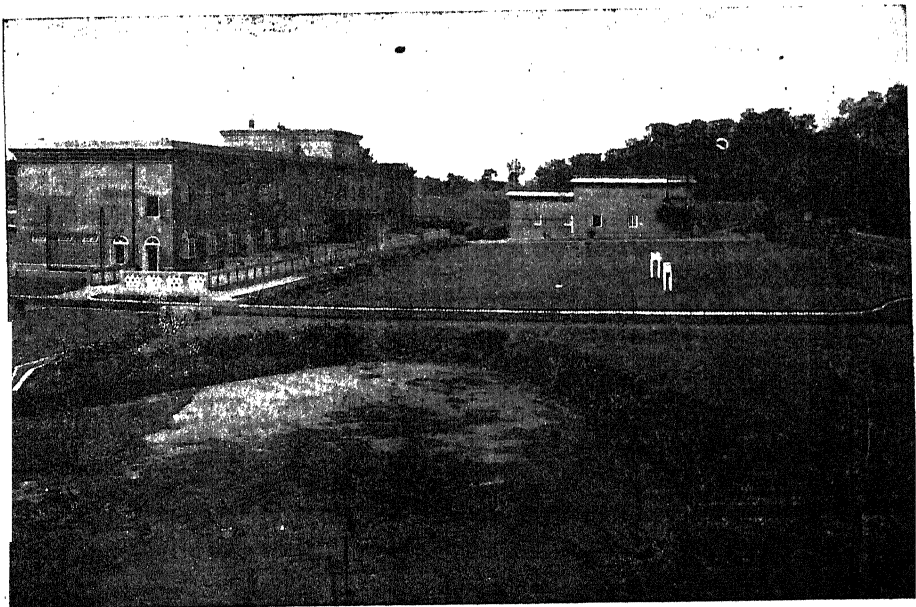
B. L. Boulevard, one of the main Road of  
Jamshedpur



Central Water Tower



Practical training of apprentices at the Machine Shop



Filter House and Pump House

40 per cent of the Company's requirements of coal, the balance being purchased from other collieries. The coal obtained from the Jharia field is of coking quality and is eminently suitable for the manufacture of metallurgical coke, employed for the reduction of iron ores. In addition to the coking coal, a large quantity of gas coal is also purchased, the gas coal being obtained from the Raniganj coalfield. With normal operating conditions, the average monthly consumption of coal in the Tata Iron and Steel Works is approximately 180,000 tons.

India's reserves of coking coal are not adequate for smelting its iron ore reserves. Of the 16,500 million tons of coal estimated to be the reserves in India, it is estimated that the reserves of good coking coal may not exceed 700 to 750 million tons at the present time. The coking coals are confined to the Giridih and Jharia coalfields. Approximately 8 million tons of coking coal are mined every year, but less than 3 million tons are used for metallurgical purposes.

### **Limestone**

The iron ores contain some deleterious material and the coke a good proportion of ash, and in order to remove these impurities, a "fluxing" material is employed during smelting, viz., limestone. The Steel Works obtain a part of their requirements of limestone from quarries located at Sakti State. The bulk of the requirements is however purchased at the present time, the supplies being obtained from the Bisra Stone Lime Company's limestone quarries at Birmitrapur in Gangpur State about 117 miles away from the Works.

### **Dolomite**

Dolomite, which is a double carbonate of magnesium and calcium, is 'dead burnt' and in this form it is used for fettling the steel furnace bottoms. Dolomite is obtained from the Steel Company's own quarries at Pamposh in Gangpur State, about 110 miles from Jamshedpur.

### **Manganese Ore**

Manganese ore is employed in the manufacture of ferro-manganese—an alloy of iron and manganese containing about 70-74% Manganese, 20-22% Iron and 5-6% Carbon. Ferro-manganese is an essential ingredient required in the manufacture of all types of steels. About half of the requirements of manganese ore is purchased, the balance being obtained from Tatas' own mines located in Keonjhar and Bonai States about 110 miles south-west of Jamshedpur.

### **Chrome Ore**

Chromite, which is an oxide ore of Chromium and Iron is employed in the manufacture of refractory bricks for use in the steel furnaces. The Steel



Company's supply of chrome ore is partly met by purchases and partly by supplies from its own mines in the Singhbhum district. The ore used generally contains about 44-48%  $\text{Cr}_2\text{O}_3$ .

### Magnesite

Magnesite, a carbonate of Magnesium, is usually 'dead burnt' and made into bricks or 'peas' for lining the steel melting furnaces. It is obtained from the Company's own mines situated in the Mysore State and is also purchased from Salem in the Madras Presidency.

### Fireclay and Refractories

Refractory materials consist mostly of fireclay products in the form of bricks and other shapes. These are purchased from plants situated in Barakar and Raniganj areas. A large quantity of fireclay in the raw state is also obtained from the Steel Company's own quarries situated at Belpahar in the Sambalpur district, about 177 miles from Tatanagar.

Silica refractories consist of silica bricks and the raw stone. The bricks are purchased from the brick manufacturing concerns, but the stone is obtained from the Company's own quarries at Sini and Kendadih. A certain quantity of pure silica sand is also obtained from Jubbulpore for the making of bottoms of the acid steel furnace. The Steel Company manufactures most of its requirements of magnesite bricks, 'dead burnt' pea magnesite and also chrome-magnesite bricks.

Other raw materials of lesser importance such as Fluorspar, Sulphur, etc. are purchased from foreign countries as these products do not occur in this country in deposits suitable for economic exploitation at the present time.

### Pig Iron.

Pig iron is the direct metallic product either solid or molten, of a blast furnace smelting iron ore. The name pig iron was derived from the manner of casting the molten metal from the furnace in sand from a main runner into smaller runners and depressions, on one or both sides—a fancied 'resemblance to a sow with a litter of suckling pigs. The smelting of iron ore, which is essentially an oxide of iron, consists of reducing the metal from the ore. The reducing agent employed is usually coke, although wood charcoal may be used in the case of small-size blast furnaces. Coal was originally used in its natural state but as it is soft and gives off a large amount of volatile matter during combustion, it is found unsuitable for use in the modern blast furnaces. It is therefore converted into coke, which is a hard porous product, almost free of volatile matter. Coke reduces the ore and also supplies the heat required for the reactions inside the blast furnace.

Iron ore, as stated above, is combined with impurities such as silica, alumina, etc. which are usually referred to as 'gangue'. Coke also contains a large proportion of ash (about 22-23% in Indian coke). In order to remove these impurities, limestone is charged as a 'flux' in the blast furnace, along with iron ore and coke, which combines with the 'gangue' or the impurities and forms slag.

### Coke-ovens

The carbonization of coal to coke is done in modern type of by-product recovery coke ovens. Coal is first blended and then crushed to suitable size, which is then charged in airtight ovens specially constructed for the purpose. The ovens are built with silica bricks and each oven is about 40 ft. long, 15 ft. high and  $1\frac{1}{2}$  ft. wide. Each individual oven is separated from the next one by a gas heated chamber, the heat being transmitted from the heating chamber to the coking chamber by direct conduction through the silica brick walls. The crushed coal is charged in these ovens and heated for about 16 to 18 hours reaching a maximum temperature of 1,000 deg. C. By the end of this period, practically all the volatile matter is driven off and the coal is converted into coke. The coke is then pushed out of the oven by means of an electric ram and quenched by a spray of water.

During the process of carbonizing coal, large quantities of gases issue from the oven, which contain valuable by-products. The gases are led to specially constructed chambers and gradually cooled and scrubbed to separate out coal tar and ammonia, benzol and toluol. The gas after it has been stripped of its by-products as stated previously, is stored in a gas-holder, from where a part of it is conveyed to the ovens to carry on the coking process and the remaining gas is distributed to various parts inside the works for heating purposes.

A contact Sulphuric Acid plant with a capacity of 50 tons of 98% acid a day, has been set up. This acid is mainly utilised for the conversion of ammonia in the coke-oven gas into ammonium sulphate which is sold as a fertiliser. Sulphuric acid is also used in pickling the sheets prior to galvanizing and also in the benzol/toluene plant. The normal products of the benzol/toluene plant are motor benzol and nitratable toluene, though small quantities of other fractions such as pure benzene, xylene, solvent naphtha, have also been produced at different times. Motor benzol is usually supplied to the different oil companies in India for mixing it with motor petrol for use in automobiles. Toluene was used exclusively for the manufacture of high explosives during the war. The average annual production of the benzol/toluene plant is about 1,250,000 gallons.

In order to cope with the increasing demand for coke, the Tata Iron and Steel Company have extended their coke capacity considerably. Originally,

the plant consisted of 180 Evence Coppee non-recovery coke ovens. These were gradually replaced by Koppers, Wilputte and ultimately Simon Carves bye-product ovens. At present the coke plant consists of three batteries (one 54 ovens and two 55 ovens) of Simon Carves and one battery of Wilputte ovens (50 ovens). The Wilputte battery can carbonize about 500/600 tons of coal per day. Each of the Simon-Carves battery is capable of carbonizing 1300/1400 tons of coal per day of 24 hours and represent the latest development in coking practice. The annual production capacity of coke is approximately 1,130,000 tons.

### **Blast Furnaces**

The Blast Furnace is a tapered cylindrical tower about 90 ft. in height and 20 ft. or more in diameter. The outside shell is of steel plates and the lining is of firebricks. The lower portion of the furnace called the 'hearth' serves as a receptacle for the molten iron and slag. The top of the furnace is sealed with movable lids called 'bells' which prevent the gases from escaping into the air, when the raw materials enter the furnace. A hot blast of air is blown into the furnace through inlets called 'tuyeres' arranged symmetrically at the bottom of the furnace.

Practically all the coke that is made is charged into blast furnaces along with iron ore and limestone for the manufacture of pig iron. These raw materials are hoisted in specially built 'skip car' to the top of the furnace by electrically operated mechanism and charged into the furnace. Calculated proportion of ore, limestone and coke are mixed in order to produce varying grades of pig iron. Through the 'tuyeres' near the bottom of the furnace, heated air is blown into the furnace under pressure from 10 to 15 lbs. per sq. inch. The raw materials charged from the top are acted upon by the countercurrent of hot gases and gradually melt as they descend in the furnace. The iron ore is reduced to metallic iron and the limestone being a flux takes up the impurities in the ore and coke and forms a slag. The molten iron and slag collect at the bottom of the furnace. The slag being lighter than the molten iron floats on top and is tapped from the furnace through a slag hole, which is situated above the level of the hole from which the iron is tapped. The operations of the process being almost continuous, periodic removal of slag and pig iron is necessary. The slag is tapped every 3 to 4 hours and pig iron once 4 to 6 hours. The liquid iron is transferred mostly to the steel furnaces for further purification and conversion into steel. A small quantity of the molten iron is also cast into 'pigs' in special 'pig'-casting machines. The slag is transferred to a far off place and dumped at present. The question of utilising the blast furnace slag for industrial purposes is now under consideration.

The blast furnace gases being combustible, are used as fuel, mainly to heat the stoves for hot blast and to generate power by burning them under boilers.

The gases before use are cleaned of the large quantities of 'flue dust' in modern gas cleaning plants.

The Tata Iron and Steel Works at present have five blast furnaces with a capacity of 600 tons, 750 tons, 850 tons, 1,000 and 1,200 tons respectively per day. The annual production capacity of pig iron is in the neighbourhood of about 1,250,000 tons. Basic and foundry grades of pig iron are produced, the analysis being as shown below :

### Tata Pig Iron

Grade.	Si. %	Mn. %	Phos. %	S. %
<hr/>				
Standard qualities				
(1)	2.75/3.25	1.0/1.50	Under '40	Under '305
(2)	2.25/2.75	1.0/1.50	"	" '05
(3)	1.75/2.25	1.0/1.50	"	" '05
(4)	1.50/1.75	1.0/1.50	"	" '05
(5)	1.25/1.50	1.0/1.50	Under '35	" '05
(6)	1.00/1.25	1.0/1.50	"	" '05
(7)	1.00 & under	1.0/1.50	"	" '05
Low Manganese				
Foundry (1)	2.75/3.25	.50/1.00	under '40	" '035
(2)	2.25/2.75	do.	do.	" '05
(3)	1.75/2.25	do.	do.	" '05
(4)	1.50/1.75	do.	do.	" '05
4x	1.25/1.50	do.	under '35	" '05
Low Manganese				
Basic special	1.00/1.25	do.	do.	do.
Low Manganese				
Basic	1.00 and under	do.	do.	do.
High Manganese				
Basic	1.00 and under	1.50/1.75	do.	do.
<hr/>				

### Steel Furnaces

The pig iron which comes from the blast furnaces contains about 5 to 6% impurities and must be purified further to convert it into steel. There are five different processes of steel making employed at the Works of the Tata Iron and Steel Co.

- (a) Open Hearth process,
- (b) Duplex process,

- (c) Triplex process,
- (d) Electric Arc Furnace process, and
- (e) High frequency induction furnace process.

Steel is made in three different shops—Steel Melting Shop No. 1 having 8 Basic open hearth furnaces and two electric arc furnaces; Steel Melting Shop No. 2 having three acid Bessemer converters and three tilting open hearth furnaces; and Steel Melting Shop No. 3 having one acid Bessemer converter, a basic open hearth furnace and an acid open hearth furnace. A High frequency furnace is installed at the Tool Steel Plant. The fundamental principle is the same in the first three processes mentioned above, viz. the oxidation and removal of impurities from the pig iron. The processes differ in that in the open hearth process, the impurities are removed from the metallic charge by the addition of other materials to the furnace, whereas in the Duplex and Triplex process, the silicon and varying proportions of manganese and carbon are removed by blowing the molten pig iron in acid Bessemer converters. The blown metal is then transferred to tilting open hearth furnaces and the heats finished, as in the open hearth process.

The fundamentals of the electric arc furnace process are practically the same except that electric energy is used as a source of heat. It is also possible to work an oxidizing as well as a reducing slag in this furnace, which helps the removal of both Phosphorus and Sulphur from the steel. This method has been developed because electrical heating is said to have certain advantages over other methods of heating from the metallurgical viewpoint. As however the electric steel is costlier than the steel produced by other processes, this method is restricted to the manufacture of special quality steels.

The high-frequency induction furnace process is different from all others in that it is simply a melting process. The calculated weight of different ingredients are melted by external heating by induction current, without any refining of the steel, as in the other processes. It is actually an improved method of making steel by the crucible process in which the selected materials were charged into large clay crucibles, which were placed in a coke fire and heated until the contents had melted.

The choice of a particular steel making process depends on such factors as the chemical composition of the raw materials, the finished products and the uses to which they would be put in service and lastly on the economies of the process.

### Basic Open Hearth Furnaces

The open hearth process of making steel is by far the most important method. The open hearth furnace is a rectangular brick structure supported on

steel frame-work and the furnace itself is a long shallow hearth which holds the molten metal. The bottom and the walls of the furnace are lined with basic refractory material, whence the process receives the name 'basic open hearth'. At each end of the furnace are ports or passages through which the gaseous fuel and air are admitted. The furnace is so designed that the flame is forced above the metal surface and melts the charge.

The raw materials employed for the manufacture of steel by the Basic open hearth process at the Tata Iron and Steel Works, are primarily steel scrap and blast furnace metal. The steel melting process is worked out in two stages—the melting down stage and the refining stage. Heavy melting scrap, iron ore and limestone are first charged into the furnace and after these have been melted down, blast furnace metal is charged into the furnace. The charge is then refined to remove the impurities. Apart from the reduction of silicon manganese and carbon content in the charge, phosphorus is also removed by the formation of suitable slags. Final alloying elements are added to the steel either in the furnace before it is tapped or in the ladle. When steel of the pre-determined composition has been made, it is tapped into ladles capable of holding 100 tons. The steel is then poured into moulds from the ladles through a nozzle at the bottom of the ladle, which can be closed by a stopper after each mould is filled, in readiness to move the ladle over the next mould. The moulds are fixed on bottom plates which are mounted on small buggies. The steel is allowed to cool sufficiently to permit the mould being lifted off or 'stripped', leaving behind the solidified steel ingot. Ingots up to ten tons in weight can be poured. There are at present in Steel Melting Shop No. 1, three 70 tons, two 90 tons and two 125 tons and one 130 tons capacity Basic open hearth furnaces. The average annual production capacity of ingots from this shop is 375,000 tons.

In Steel Melting Shop No. 2, the 'Duplex' process of steel making is followed, which as explained before, is a combination of the acid Bessemer and basic open hearth processes. The molten pig iron from the blast furnace is first stored in a hot metal mixer so that the metal may be of uniform analysis. This mixed metal is then transferred to an acid lined Bessemer converter which is a pear-shaped vessel fixed on trunnions. An air blast is blown through the converter which reduces the silicon, manganese, and carbon contained in the iron as desired. The semi-finished blown metal is then transferred to a tilting basic open hearth furnace, where the heat is finished as in the open hearth process. In Steel Melting Shop No. 2 there are three 25 tons Bessemer converters, one 250 tons and two 200 tons capacity tilting basic open hearth furnaces. The average annual production capacity of ingots from this shop is 720,000 tons.

For the manufacture of acid steel specified for the manufacture of wheels, tyres and axles, the steel making process employed in the Steel Melting Shop No. 3 is what is called the "Triplex" process. In this process, the blast furnace

metal is first blown in the acid Bessemer converter to partly remove the silicon, manganese and carbon contents as desired, and then charged into a basic open hearth furnace where the metal is dephosphorized. The dephosphorized metal is then transferred to an acid open hearth furnace where the heat is finished. Steel is also made in this shop by the Duplex process, as described previously. In this steel melting shop, there is one 25-ton acid Bessemer converter, a basic open hearth furnace and an acid open hearth furnace, each of 50 to 60 tons capacity. The average annual ingot production capacity of this plant (acid and basic steels) is about 65,000 tons.

There are two Electric arc furnaces in Steel Melting Shop No. 1 in which special quality steels are produced. The electric arc furnace consists of a heavy steel shell lined with refractory material. It has a charging door on one side and a spout for tapping the steel on the opposite side. The vessel is equipped with a removable roof through which three graphite electrodes pass. The electrodes can be raised or lowered by automatic and manual controls. A heavy current of electricity is passed between the electrodes and a continuous arc is struck. The heat generated by the electric arc melts down the charge inside the furnace. The charge of an electric furnace usually consists of selected steel scrap of known analysis.

The two electric arc furnaces in the Tata Iron and Steel Works are of approximately  $5\frac{1}{2}$  tons capacity each and their average annual ingot production capacity is approximately 15,000 tons. In addition to these two furnaces, there is an electric arc furnace of  $3\frac{1}{2}$  tons capacity in the Steel Foundry for making high quality alloy steel castings.

The manufacture of high quality alloy, tool and special steels was taken up in 1943 to meet the urgent requirements of the war and a separate Tool Steel Plant was set up for the purpose. The Tool Steel Plant consists of one-half ton High frequency induction furnace and other ancillary equipment such as forge hammers, reheating and annealing furnaces, machine tools, etc. required for the production of the high quality products. In addition there are also two experimental high frequency induction furnaces of 75 lbs. and 25 lbs. capacities in the Research and Control Laboratories. These furnaces are employed for research and developmental work.

### Shaping and Treating of Steel

Modern rolling mills at the works enable the production of practically the full range of British standard sections. Considerable improvements have been made and additional equipment installed in order to be in a position to meet the most exacting modern requirements.

The rolling mills consist of the following units :

- 40" two-high reversing blooming mill,
- 35" roughing mill,
- 28" three-high rail and structural mills,
- 24" and 18" continuous sheet bar and billet mills,
- 12" Morgan merchant mill,
- 16" and 10" bar mills,
- Sheet mills, and
- 96" plate mill.

The stripped ingots are hauled to the soaking pits at the blooming mill. These soaking pits are fired by coke-oven gas and producer gas. The ingots are reheated to a uniform temperature suitable for rolling. Ingots for the manufacture of wheels and tyres are sent to the wheel, tyre and axle plant direct for processing. The function of the blooming mill is to reduce the ingot to a size which will enable the other mills to continue the rolling to obtain the desired sections.

The 40" reversing blooming mill consists of two power-driven cast steel rolls on which are cut suitable roll passes. The rolls are mounted in a rugged housing and held in position by heavy screws. After the ingot has passed between the rolls two or three times, it is turned on its side by a manipulator and the frequent kneading of the ingot on all the four sides gives it the proper strength, while the metal is elongated at the same time. The steel blooms and slabs are next sheared at a hydraulic shear.

During the process of rolling, it is usually necessary to reheat the blooms, slabs and billets at the different mills.

The blooms are either rolled in the 24" and 18" continuous Sheet Bar and Billet Mill, to sheet bars, tin bars, sleeper bars, billets etc. or are transferred to the 35" roughing mill and 28" rail and structural mills for rolling into rails and structurals.

The usual products rolled in the 28" mill are rails, beams, angles, channels, and other structural forms. For controlled cooling of rails, four Sandberg ovens have been installed over the hot bed of the finishing end of the rail mill, as the slow cooling of the rails improves the strength and wear-resisting properties of rails.

The sheet bars, sleeper bars and billets from the Sheet Bar and Billet mill are subsequently conveyed to the respective finishing mills, where they are finally rolled into finished products.



The billets are rolled, after reheating, into light structurals and bars at the 12" Morgan merchant mills or at the 16" and 10" bar mills. Fishplates and light rails are also rolled in the bar mill.

Sheet bars from the Sheet Bar and Billet Mill are rolled at the Sheet mills into black sheets, in different sizes and gauges. The Sheet mill consists of three new mechanically operated units and four hand-operated units of the old type. In addition to commercial quality sheets produced at the Sheet mills, special quality sheets are also produced such as deep drawing quality sheets, panel plates, high silicon steel sheets required by the electrical industries, etc.

The heavier gauge sheets are rolled singly whereas lighter gauge sheets are rolled in packs, the number of sheets in a pack depending on the gauge of the finished sheets. For lighter gauges, each pack may contain as many as 8 to 10 sheets. The packs are sheared and the sheets are opened out. The sheets are then cold rolled to impart to them a flat surface. The annual production capacity of sheets is approximately 175,000 tons, depending on the average gauge and size of the sheets rolled.

There are 10 modern gas-fired Lee Wilson incandescent type annealing furnaces at the Sheet Mills for the annealing of sheets. In addition, there is one electric annealing furnace at the Sheet mills, for the annealing of different grades of electrical steel sheets.

Black sheets which are required to be galvanised, are first pickled in dilute sulphuric acid. The pickling operation removes the scale from the sheets and prepares the surface for galvanising. The pickled sheets are washed and then are galvanised by the 'hot-dip' process.

Corrugated sheets—either black or galvanised—are produced on rotary corrugating machines.

The waste pickled liquor is treated to recover the ferrous-sulphate, which is sold as such or is converted subsequently into different shades of red oxide of iron.

Slabs from the blooming mill are taken to the 96" plate mill where they are rolled into plates of varying thickness from  $\frac{1}{8}$ " to 3" and to a maximum width of 84". There is a gas fired normalizing furnace at the plate mill capable of normalizing plates up to 1" thickness.

In order to meet the requirements of the essential rolling stocks of the Indian Railways, a Wheel Tyre and Axle plant was established in 1941. For the manufacture of wheels, and tyres, round corrugated bottom poured ingots of different sizes are sliced into blocks or 'cheeses'. These cheeses, after reheating to proper temperature, are pressed into rough blanks on a 4,400 ton hydraulic

press. The rough forged blanks are rolled in an Edgewater Combination Tyre and Wheel mill. Both tyres and wheels are rolled on the same mill by making the necessary alterations in the equipment to produce the different profiles. The products are finished by proper tread quenching and controlled cooling, to enable them to stand the rigid tests. Axles are produced by forging blooms supplied from the rolling mills. The forging is carried out under steam hammers and the axles are suitably normalized and finish-machined to required dimensions.

There is also a Sleeper plant consisting of two presses for the manufacture of pressed steel sleepers for the Railways from sleeper bars rolled at the sheet bar and billet mill.

The Steel Company also manufacture, in an up-to-date factory, a variety of agricultural and other tools and implements consisting of picks, powrahs, hammers, axes, mattocks, crow-bars, clawbars, chisels, wedges etc. All the steel used in the production of such tools is made in the Steel Works.

Besides the iron and steel producing plants indicated above, the Tata Iron and Steel Works has to maintain ancillary plants essential for the operation and maintenance of the different furnaces and mills. These plants chiefly consisted of :

- (a) Boiler plants consisting of various types of gas and coal-fired boilers.
- (b) Three electric power plants having a total installed turbo-generator capacity of 130,500 KW.
- (c) Mechanical and maintenance shops consisting of machine shops, turning shops, structural and blacksmith shops, foundries, welding shops, etc. where all the repairs and maintenance jobs of the plant are attended to promptly and efficiently.
- (d) A brick plant with up-to-date machinery to manufacture bricks from magnesite and chrome refractories has also been installed.

In addition to the pig iron and the extensive range of mild steel products manufactured at the Steel Works, large tonnages of special quality steels are also produced.

In the field of Alloy Steels, the Tata Iron and Steel Works have developed two types of low alloy high strength steels, known as "TISCROM" and "TISCOR". The former satisfies the requirements of the British Standard Specification 548 for high tensile structural steels and over 17,000 tons of this material has been used in the construction of the new Howrah Bridge at Calcutta. 'TISCOR' which is a Chromium-copper-silicon-phosphorus steel, corresponds to the American high yield strength corrosion resistant structural steel and is employed where strength with a reduction of weight in construction is required.

A large variety of alloy, tool and special steels have been successfully manufactured during the war to meet the direct war demands and since then a steady output of the high quality steels has been maintained to supply the civilian requirements. The range of steels on production include all types of tool steels used in general engineering practice and machine construction such as high speed steels, hot die steels, steels for punches and dies, shock-resisting steels, etc. Stainless steels for the manufacture of surgical instruments, high silicon steels for the manufacture of electrical machinery, mint die steels for coinage dies, cobalt and tungsten high speed steels for machining of metals are a few important types of the large variety of tool and alloy steels produced by the Tata Iron and Steel Company. To meet the pressing demands of the war, the Tata Iron and Steel Company produced over 20,000 tons of special quality bullet proof plates and other ordnance steels and also ferro-tungsten, ferro-titanium and silico-manganese from the raw materials available in the country.

### **Research & Control Laboratories**

The Tata Iron and Steel Company, having felt the need to extend research in problems bearing on the production and processing of steels, erected New Research and Control Laboratories in 1937, which are perhaps one of the finest set of laboratories attached to any single steel producing unit. These laboratories represent the first large-scale research laboratories constructed by private industry in this country.

The metallurgical section is provided with testing rooms for routine mechanical testing of the Company's products and with laboratories for the heat treatment of steels, the etching of large sections of steel, including ingots, in order to observe their internal structures. There is also a special laboratory for carrying out very delicate and specialised mechanical tests; a Metallographic laboratory with high-powered microscopes for investigations into the internal structure of metals; a Physics laboratory for determining physical properties, cooling curves, etc. of metals; a laboratory for the investigation of corrosion problems, etc. A High Frequency Induction melting equipment, to manufacture small quantities of special grades of steel for experimental and industrial purposes is also provided in this laboratory.

The Chemical Laboratory in the new Control and Research Laboratories carries out the routine analysis of all raw materials used in the manufacturing processes, ferrous alloys, non-ferrous metals and alloys, coal, coke refractories, boiler waters, oils, lubricants etc. Research work is also undertaken on various chemical problems arising in the plant.

The Refractory Research and Testing laboratory is fully equipped to carry out tests and research relating to refractories.

### **Welfare Activities**

In order to promote the welfare of its employees, the Tata Iron and Steel Company have brought into existence a large industrial city. Jamshedpur is about 25 sq. miles in area and is 532 ft. above mean sea level.

The Tata Iron and Steel Company have made ample provisions for housing a large number of its employees and are also responsible for all the services of a municipal nature such as provision of filtered water, electricity, sanitation and medical facilities, educational facilities, roads, markets, parks, etc. The total outlay on the town has reached a figure of over Rs. 4 crores and a considerable expenditure is being incurred at the present time to enlarge its housing facilities and for the development of the town in general.

The welfare activities of the Works cover many directions. The Safety First Campaign enthusiastically pursued in the various departments of the Works is a whole time job ceaselessly conducted. Works canteens for catering to the needs of the workmen and also creches for women employees have been provided. A Suggestion Box Scheme is set afoot to stimulate employees to offer suggestions which receive prompt and sympathetic attention. The suggestions found useful are awarded cash prizes.

### **Technical Institute**

The Tata Iron and Steel Works have established a Technical Institute to train the skilled technical personnel required by them. Two classes of apprentices are trained at the Institute: (a) Trade apprentices, who are trained as skilled artisans, and (b) Graduate apprentices, who are trained for holding supervisory positions in the Works.

Under the Trade apprentice scheme, trainees between the ages of 15 and 18 and with a minimum educational qualification of a middle English pass course are recruited to undergo a two years training in a separate workshop specially set up for the purpose. After the training, they are absorbed in the various departments of the Works.

The Graduate apprentices are selected from among applicants below 24 years of age with a minimum qualification of a degree in Mechanical or Electrical Engineering or Metallurgy or a Diploma from recognised technical institutes and they are given a combined theoretical and practical training for two years before they are assigned to different departments of the Works.

The training imparted at the Institute has been recognised to be of a high order and the establishment of the technical institute by the Tata Iron and Steel Company has made it possible for them to Indianise a large number of higher posts which were previously held by foreigners.

A number of ancillary industries have grown round the Steel Works on account of the facilities afforded and there are to-day several important associated companies, of which the Tinsplate Company of India Limited, manufacturing tin plates, the Indian Steel and Wire Products Limited, manufacturing steel rods and wire products, and the Indian Cable Company, manufacturing electrical cables and wires, are the more important ones.

The Tata Engineering and Locomotive Company, a sister concern of the Tata organization, has been established in Jamshedpur. This Company has taken up the manufacture of locomotive boilers and will eventually manufacture complete locomotives and other heavy engineering machinery.

The size and growth of the Tata Iron and Steel Works marks the most significant development in the history of Industrial India. The industrial development of the country has been made possible by the continued expansion and modernization of the Tata Iron and Steel Works—the foremost industrial enterprise of the country, and the works are a lasting monument to the forethought and genius of the great Mr. J. N. Tata.

## THE SINGHBHUM COPPER BELT & THE INDIAN COPPER CORPORATION LTD

The whole length of the belt contains ancient mine workings whose age is unknown, but whose size and number point to a large and thriving industry and a comparatively high degree of civilisation that worked the belt for copper in ancient days. The existence of copper in Singhbhum has however only been known to British enterprise since the early part of last century and the first hint of the occurrence of copper in Dhalbhum was made exactly 113 years ago in 1833 by a Mr. Jones.

In 1847 the occurrence of copper in Singhbhum was first definitely established by Captain J. C. Haughton, assistant to the Governor General's Agent in the South West Frontier but it was not until 1857 that the first Singhbhum Copper Company was formed by certain Calcutta interests and dissolved in 1859.

In 1862 a Company—The Hindostan (Singhbhum) Copper Company—commenced operations at Rajdoha with a capital of £120,000, but in 1884 this Company became defunct.

In 1869 Valentine Ball, an eminent geologist wrote an interesting paper endeavouring to show that the Jats or Seraks (lay Jains) were the ancient people who first worked these copper deposits.

In 1891 attention was again turned to the district and a portion of the copper belt in Dhalbhum was taken on lease direct from Government. From this concession the Rajdoha Mining Company selected an area extending from Rakha to Rajdoha and comprising about 24 sq. miles.

Work was done by the new Company at both Rajdoha and Rakha but appears to have been limited by lack of funds.

As a result of a report on the copper prospects of the district by Sir Thomas Holland between 1905 and 1909 the Geological Survey of India put down several borings along the belt in Singhbhum. The result of these borings aroused further interest and the Cape Copper Company under the management of Messrs. John Taylor and Sons secured an option on the lease held by the Rajdoha Mining Company.

In 1907 and in 1908 the Cape Copper Company bought the lease outright for £. 14,000 from the Rajdoha Mining Company and carried on prospecting and development work at Rakha mines until 1914, when the mill was started and production commenced. Production operations continued until 20th June 1921 when the Receivers took over the mine and on 31st March 1922 production ceased, although the mine was kept open until 1931.

An option was taken on this property by the Indian Copper Corporation Ltd. in 1929 but was not exercised.

In 1920 the Cordoba Copper Company, under the management of Messrs. John Taylor and Sons took an option on the Mosaboni area of some 20 sq. miles from the Cape Copper Company and started prospecting. The option was exercised in 1924 and the mining rights of the area purchased from the Cape Copper Co. On July 21st 1924 this Company was reconstructed as the Indian Copper Corporation Limited with a capital of £225,000 and the new Company at the same time took over the properties of the North Anantapur Gold Mining Co. and the Ooregum Gold Mining Co. at Sideshur and Kharswan. Work was however confined to the Mosaboni area where development continued until February 1927, when the management of the Indian Copper Corporation Limited was taken over by the Anglo-Oriental and General Investment Trust Ltd. Debentures for £350,000 underwritten by the new management supplied funds for the erection of power plant, concentration mill, and smelter on the north side of the Subarnarekha river near Ghatsila. Erection of plant commenced without delay resulting in the commencement of production operations in the closing months of 1928.

In July 1930 a Rolling Mill for the production of Yellow Metal or brass sheet was completed and the first Yellow Metal sheet made in India was produced.

In 1931 the technical management of the Corporation was handed over to the New Consolidated Goldfields, South Africa Limited, under whose management operations still continue.

In 1932 further Debentures for £125,000 supplied funds to increase the plant and increase production by 50%. This extension of plant was completed in October 1933 and the authorised capital of the Corporation now stands at £900,000, all Debentures having been paid back.

Since ore winning operations commenced in 1929, up to the end of 1945, a total of 5,051,753 short tons of ore has been treated for a production of 93,818 long tons of refined copper. The average grade of ore treated was 2.214% copper.

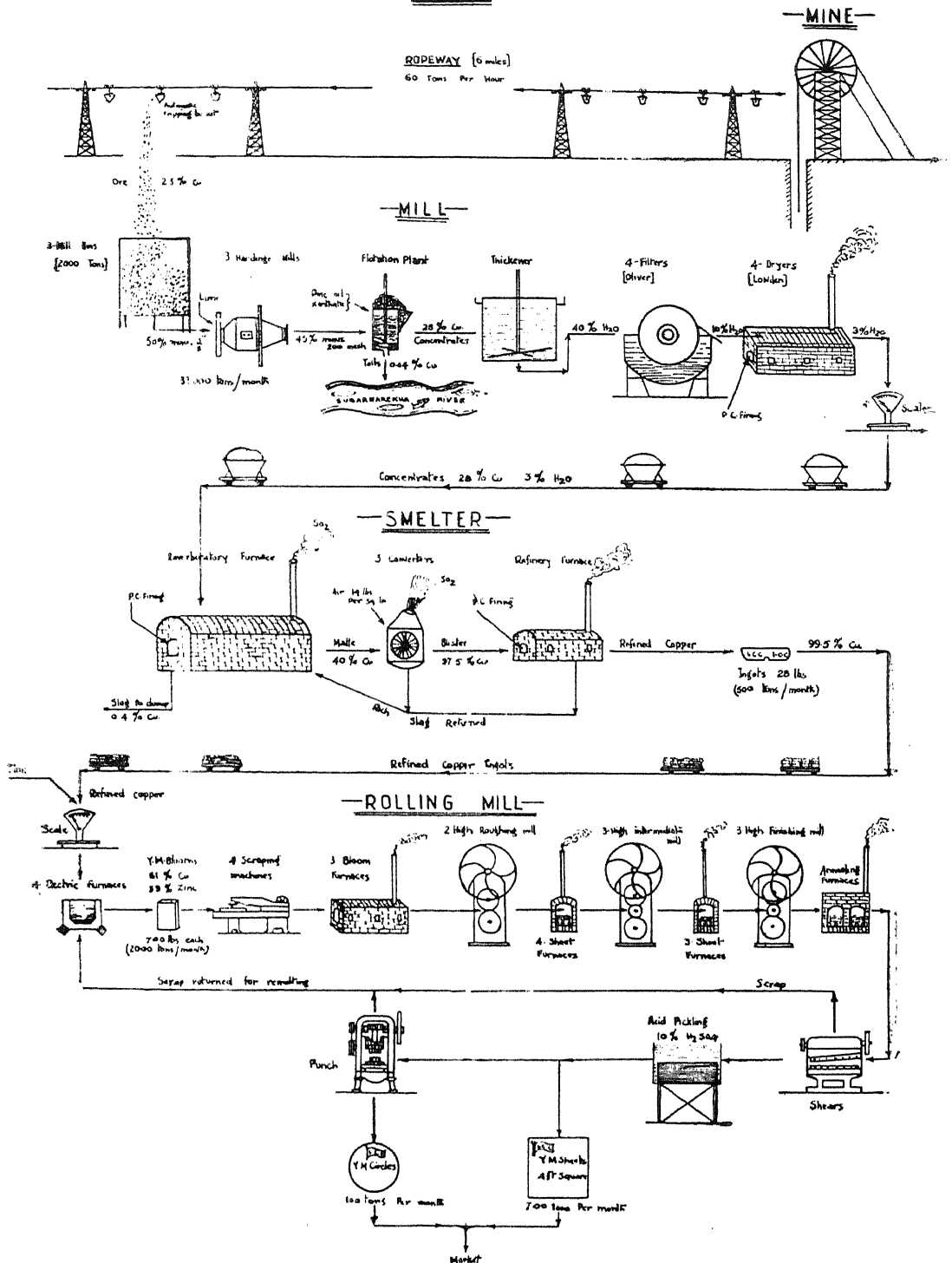
### Operations

The sequel of operations from the mining of ore to the production of refined copper ingot and yellow metal sheet and circles is given below and is also outlined in the accompanying diagrammatic flow sheet.

### The Mines

The Corporation operates three mines. Mosaboni and Badia on the same line of lode adjoin one another and workings extend for a horizontal distance of  $2\frac{1}{2}$  miles. It is possible to walk from one end to the other without coming up to the surface.

**1947**





A smaller mine at Dhobani is situated one mile to the west of Mosaboni. The method of extracting ore is similar in all three mines. A brief description of the Mosaboni Mine is given below.

### Mosaboni Mine

Two parallel lodes on ore bodies dip at approximately  $30^{\circ}$  from the horizontal and are developed by inclined shafts and levels or tunnels driven along the lode at different horizons. The distance between horizons measured down the incline or dip of the lode is about 220'. The intervening ore is removed by "stoping" and falls or is scraped down to chutes. Tram lines are laid along the different levels and the ore is taken from the chutes and trammed to ore bins in the main hoisting shaft.

All breaking of ground is done by rock drills operated by compressed air and the holes so drilled are blasted each night. The explosive used is gelignite. On the present scale of operations some 20 tons per month of explosives are consumed.

From the Shaft ore bins the ore is hoisted in  $5\frac{1}{2}$  ton self dumping skips by a 450 H. P. Electric Hoist operating a double skip or cage road to a surface ore bin in the shaft head frame.

This surface ore bin feeds a primary crushing plant where the ore is crushed in two stages to a size of "minus  $\frac{1}{2}$  inch" and where the elimination of waste rock by hand picking is carried out.

From the primary crushing plant the crushed ore is carried by belt conveyor to the aerial ropeway bins, and from there by aerial ropeway a distance of 6 miles to the concentrating mill and smelter at Moubhandar. Surface plant at the mine, in addition to the electric hoist and crushing plant already referred to, consists of compressed air plant, drill sharpening plant, workshop and foundry.

All plant is electrically operated and power is supplied from the Corporation's main power plant at Moubhandar over a duplicate overhead power line at a pressure of 11,000 volt.

### Moubhandar

At Moubhandar the aerial ropeway discharges the roughly crushed ore into reinforced concrete ore bins feeding the Concentrating Mill.

In the Concentrating Mill the ore is first ground by ball mills to the requisite degree of fineness to separate the copper bearing mineral from the surrounding "gangue" or waste rock, and then passes to the "Oil Flotation" plant, where the copper-bearing mineral is separated by flotation and then filtered and dried.

The resulting product known as "Concentrates" consists essentially of finely ground copper-bearing mineral assaying approximately 30% copper and containing approxi-

mately equal parts of copper, iron and sulphur. The waste or tailings are pumped away and settled on adjoining waste land.

The dried concentrates are now ready for treatment in the smelter, where in successive stages the sulphur content is driven off as sulphur dioxide gas and the iron and other impurities are fluxed and removed in the form of slag, leaving molten refined copper which is ladled and cast into ingots.

It is noteworthy that from the time the ore is deposited in the underground bins until the worthless crushed rock (pulp) from which the copper sulphide has been extracted, is pumped away the whole process is automatic, no handling being necessary.

The successive stages in the smelting plant are pulverized coal fired reverberatory furnace, Bessemer Converters and pulverized coal fired refinery furnaces.

The resulting product known as 'BS' or 'Best Select' Copper Ingot assays from 99.2% to 99.6% Copper. Normally, a portion of this is marketed in ingot form, the main consumers being the Calcutta and Bombay Mints, the Indian Railways and the Calcutta Bazaar. The major portion is converted by the addition of zinc into brass or 'yellow metal' sheet having a composition of 62% copper and 38% zinc.

In the Yellow Metal Foundry copper and zinc ingots are melted in electric induction furnaces and cast in water-cooled moulds as "blooms" in which form after preliminary scraping of the surface they are suitable for rolling.

In the Rolling Mill, two-stage hot rolling is carried out, the blooms being heated in specially designed furnaces, rough rolled to "plates", reheated, rerolled to the requisite gauges and cut into 4 ft. square sheets.

Annealing and pickling of the finished sheet are necessary before they are ready for the market and a small proportion of the total output is cut and marketed as "circles."

Output is on a scale of 700-800 tons of finished sheet per month and all output is marketed in India, and distributed to consumers through the metal markets of Calcutta, Bombay and Madras.

The power plant situated at Moubhandar supplies power for all plants at Mosaboni and Moubhandar in addition to camp lighting, water supply etc.

The plant consists essentially of a battery of six water-tube boilers fired by pulverized coal, and six high speed turbines operate alternators of a total capacity of 5,875 K.W.

A central coal pulverizing plant and two unit pulverizers reduce slack coal to the necessary fineness for firing by pulverized coal and all water required for

domestic supply and the numerous processes is pumped by electric pumps from the Subarnarekha river.

An assisted siding connects the plant site to the Bengal Nagpur Railway main line at Ghatsila and the Corporation is therefore well-served for all essential supplies.

The Corporation employs a total of 6,000 to 7,000 persons of which about 5,000 are engaged in the Mines and in the Workshops at Mosaboni whilst the balance of about 1600 is engaged in the Reduction Works and Rolling Mill at Moubhandar.

### **Future Possibilities.**

At the present time of writing, the Copper Industry with the lifting of the import duty on unwrought copper together with the large rise in costs, is in a difficult position, for the ore is of low grade and cannot compete in costs with free imports of copper. Apart from the above, however, development is in an interesting stage and the Indian Copper Corporation, subject to the above mentioned adverse factors being overcome, is prepared to spend a large amount of capital on developing the Mosaboni mine to much greater depths where the possibilities of the mine opening up well are considered to be favourable. If such hopes were to be realised, its effect on the prospects of India expanding her copper production at favourable sections along the Singhbhum Copper Belt would be considerable and it would appear, in view of the national importance of such a metal as copper, that every opportunity should be taken to develop the industry.

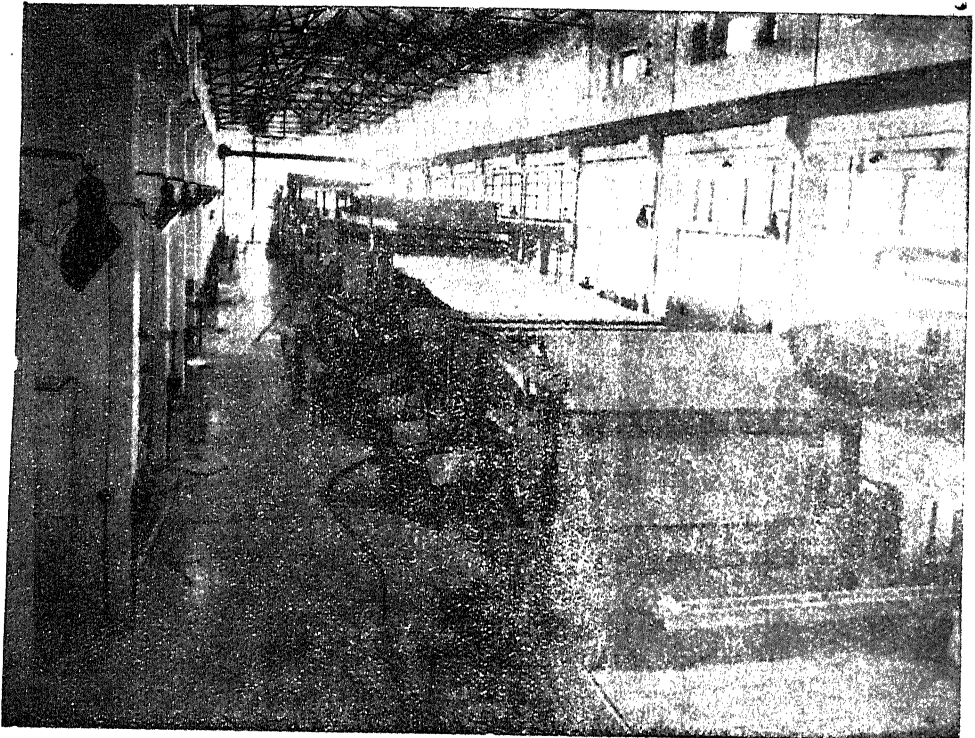
## DALMIANAGAR

DALMIANAGAR, the seat of Rohtas Industries Ltd.,—a Dalmia-Jain Enterprise —is one of the most important pivots of industrial activity in the country.

Once an unknown spot in the jungles, less than a mile from the famous Sone Bridge, Dalmianagar of to-day owes its existence to the vision of one man—Seth Ram Krishna Dalmia, the founder of the town, which has been aptly named after his ancestors.

Visualising the immense importance of the place, he took upon himself the then seemingly impossible task of building large industries which would stand second to none in the country. His dreams have taken shape and to-day we find centred in one place, a large number of major industries, differing from one another both in kind and content, while surpassing in magnitude and importance all others of their kind in the country. It redounds to the credit of the country that these enterprises were conceived by Indian brains and are financed and run by Indian Capital and Labour.

1. *Paper Factory*:—Equipped with a combined cylinder-mould and Four drinier

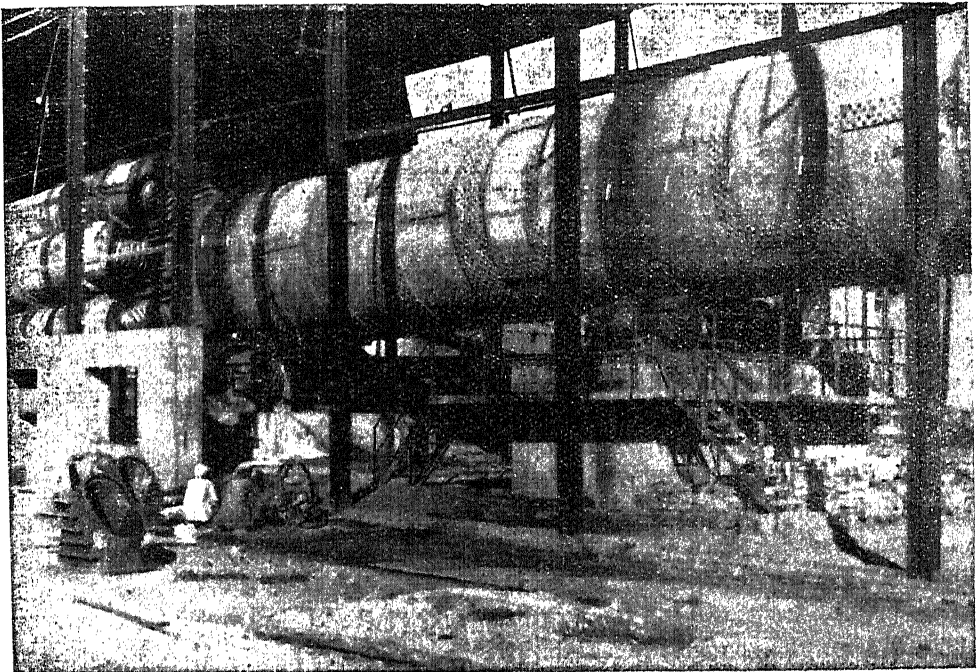


A general view of Paper Machine

wire machine and a Yankee Cylinder weighing 28 tons, it produces the finest quality and varieties of boards, specially Duplex and Triplex. Its huge Mechanical Pulp Grinders with a grinding capacity of 20 tons of Mechanical Wood Pulp per day are the first of their kind in India. Apart from this unit, the two Board Machines fabricated in the Central Workshop of "ROHTAS" are manufacturing Special Boards in great demand in India. The secrets and the specialised process of making leather boards were generally unknown in India till 1940. Ours are the pioneering efforts in making leather boards. We made and assembled the machinery in our Workshop and have the satisfaction that our leather boards, chemically neutral Mill Board and Glazed Boards are unsurpassed.

Extensive programme of extension are in hand including production of high grade bleached pulp from bagasse and special varieties of boards.

2. *Cement Factory*:—An up-to-date Cement Plant with provisions of automatic transport of raw and finished products, is not only the biggest single plant in India,



A general view of 500 feet kiln in cement factory

but is reckoned amongst the biggest of its kind in the world. The Swing Hammer can crush every hour 100 tons of limestone blocks of two feet size into small chips of one inch. The Raw and Cement Mills which reduce these chips and clinker into fine powder are each worked by 1,300 and 1,000 Horse Power motors respectively. The Giant Rotary Kiln which is over 12 feet in diameter and 500 feet long was the

biggest single lot of industrial machinery ever handled by the East Indian Railway. An automatic process packs, weighs and moves a bag of cement into wagons every four seconds.

The scheme of doubling the capacity of this plant is now complete and machinery is expected to arrive early next year.

3. *Sugar Factory*—A double carbonation and double sulphitation single unit plant with a daily crushing capacity of 1,800 tons and fitted with 17 rollers and two knives produces the finest sugar crystals "R.S." quality for table use. Sugarcane is transported to the factory through waterways, aerial rope-ways, railways as well as by motor lorries and bullock carts. From cane to the table the sugar is untouched by hand.

4. *Vanaspati Factory*—Utilisation of the surplus hydrogen in our Chemical Factory originated the idea of putting up the Vanaspati Plant which was designed by our experts and fabricated in our own workshop at Dalmianagar. Manufacture of washing soaps is an allied industry.

Order has been placed for an up-to-date and automatic toilet soap making plant, which is expected to be shipped by the end of this year.

5. *Chemical Factory*—Manufactures caustic soda, chlorine, bleaching powder, synthetic hydrochloric acid, barium salt and sodium sulphide. The Mercury Cells erected in 1939 were turning out caustic soda and chlorine just sufficient to meet the requirements of our Paper Factory. Diaphragm Cells designed by our own experts have been added, of late, and bleaching powder of standard quality is being manufactured for market supplies. Reverberatory Furnace has also been put up which produces barium salts and sodium sulphide. Synthetic hydrochloric acid has been successfully marketed.

6. *Sulphuric Acid Factory*—The first rectangular chamber for making sulphuric acid was put up in the year 1942. Increased demands necessitated addition of two more rectangular chambers which have raised the annual output of sulphuric acid to 2,400 tons. Further completion of two circular chambers of our own design is nearing. An up-to-date 10-ton Contact Process Plant has been ordered in England which will be working with Vanadium as the catalyst. Ferric alum and potash Alum are regularly manufactured to meet the demand of the country.

7. *Asbestos Cement Factory*—Designed, fabricated and erected by our own staff, the plant is turning out plain and corrugated sheets as also other asbestos cement products. All researches to utilise Indian asbestos fibre are not yet bearing fruit and the foreign suppliers are not entertaining contract for supply of raw fibre for one reason or the other. This is keeping the plant closed temporarily.

8. *Pole and Pipe Factory*—Availability of Sone river sand, cement and stone chips in abundance at Dalmianagar prompted us to put up this factory. Reinforced Cement Concrete Pipes of different sizes are being made to satisfy public demands for different purposes. Constant demand for poles for electrical over-head transmission is also met by this factory.

9. *Wood Working Factory*—This factory was equipped with a most up-to-date and modern American Plywood Factory with a 88" Veneer Lathe and 7' × 5' Hot Press which has now been packed for being installed in Assam or where suitable wood can be made available in ample supply. It is now left with a Saw Mill and a Carpentry Shop. Saw Mill consists of Circular, Band, Cross-cut and other kinds of saws, planing machines, etc., and is designed for sawing wooden planks for different uses. Most of the machines in this mill were fabricated locally to meet emergencies. Carpentry Shop caters for different requirements, such as furnitures, wooden articles for factory use and building construction.

10. *Cardboard Box Factory*—To meet the heavy demands of cartons and boxes for packing our products and the extra urgent operational demands of the Supply Department for Defence requirement, this factory took the present output of 15 lacs of boxes and cartons per month. Different machines are designed and fabricated by our staff. Demands are abnormally decreased for the present.

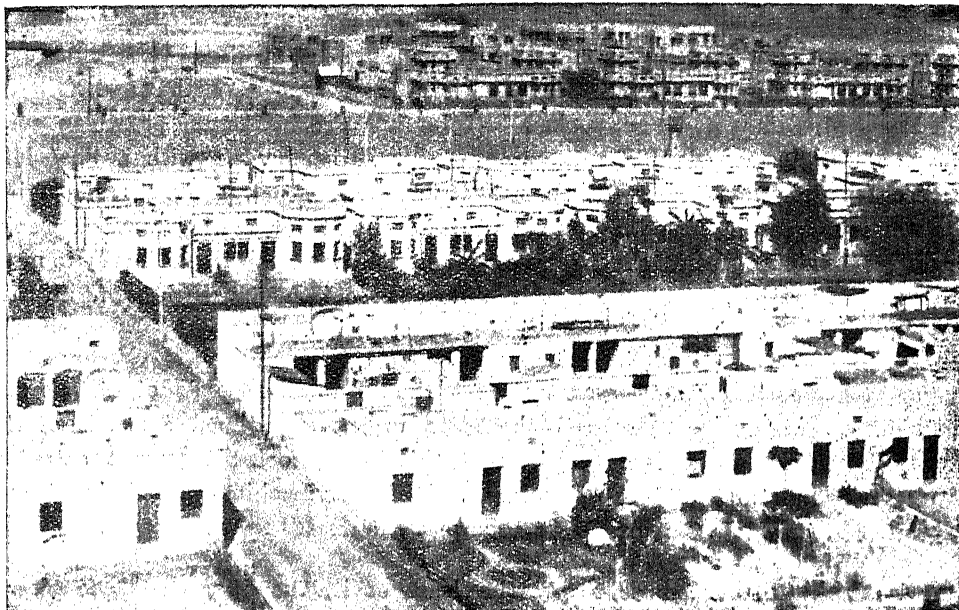
11. *Central Workshop*—is, to say the least of it, the very backbone of our industry. It is an up-to-date workshop equipped with most modern machines and a well-designed foundry shop. During war most of the machines for maintenance and new erection were designed and fabricated in this workshop. The Electrical Repair Section repairs and maintains heaviest as well as finest electrical equipment of the industry.

12. *Central Power House*—the heart of the industries, is equipped with 2 Turbo Alternator sets, each having a capacity of 6,000 K.W. Besides meeting the needs of the industrial town of Dalmianagar, it supplies energy to the towns of Dehri and Sasaram. Power is supplied to the East Indian Railway and also to the Government of Bihar under the Bihar Lift Irrigation Scheme for working tubewells to supply water for agricultural purposes. To meet the new demands of extension and new schemes at Dalmianagar, a new 10,000 K.W. Turbo-Alternator set is expected to come in commission by middle 1949. The extension and modernisation of the present Power House will cost about 50 to 60 lacs of rupees.

## EMPLOYEES WELFARE ACTIVITIES

The management has always been keen to provide all possible amenities to their employees, special emphasis having been laid on their housing, recreation, entertainment, health and happiness.

*Housing*—With its modern bungalows, rows of well-planned staff quarters interspersed with parks and lawns and miles of cemented roads with trees on both sides, Dalmianagar is a model of method and neatness in town-laying. Free supply of water and electricity all day and night and a private telephone system add to



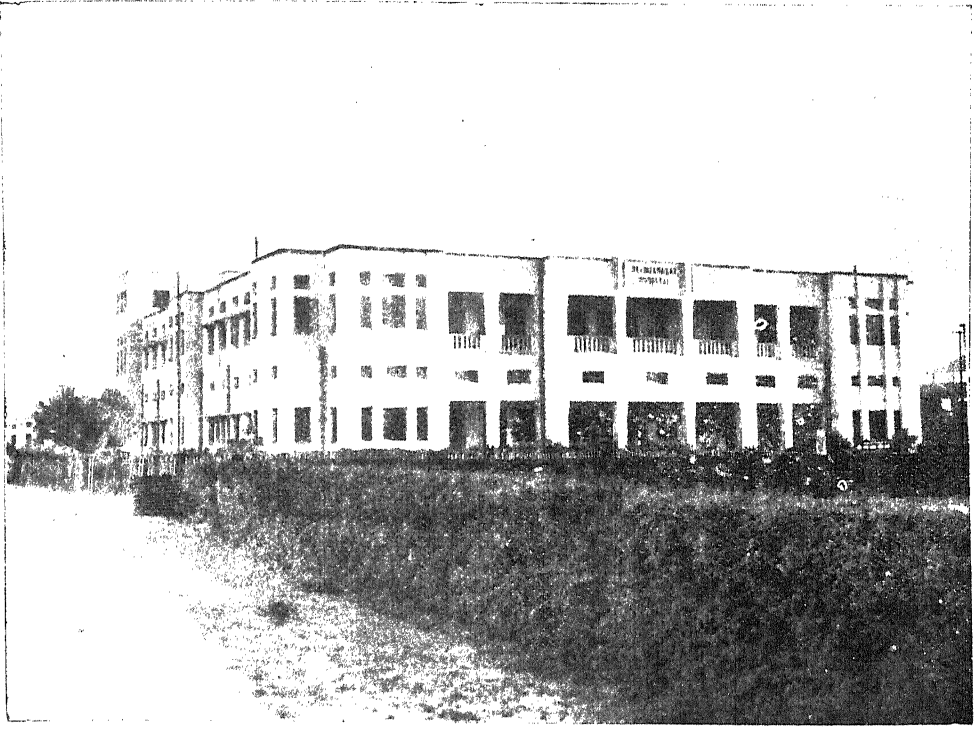
General view of residential bungalows and quarters interspersed with playgrounds

the amenities of life. Schemes for underground drainage prepared under expert supervision have already been approved by the management and as soon as the time permits, this will be introduced in all the quarters and bungalows which to-day total 1,500.

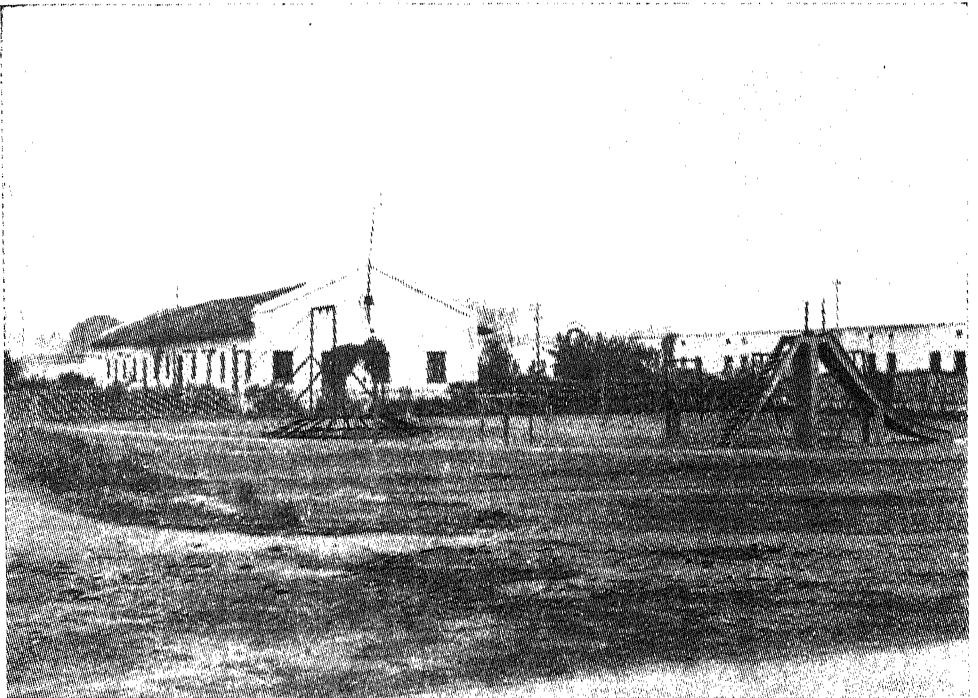
*Broadcasting*—The Local Broadcasting Station provides daily entertainment to the residents and attempts to keep them well-informed of the up-to-date news and cross currents of the world affairs through a dozen loudspeakers installed to cover the entire colony. The programme is relayed every morning and evening.

*Hospital*—Dalmianagar is proud of having an up-to-date hospital with a large double storeyed building, providing free treatment according to Allopathic, Ayurvedic, Homeopathic and Unani systems of medicines. X-ray equipment has also been installed and Ophthalmic & Electro-therapy cases are also successfully treated in the hospital. A recent addition of 50-bed American equipment will be a boon for the indoor ward. There is separate provision of the Female Ward—Indoor and Outdoor with special arrangements for maternity cases. This well-equipped hospital, having an up-to-date Operation Theatre, provides highly specialised medical and surgical treatment for indoor and outdoor patients.





Dalmianagar Hospital



Children's Park, Dalmianagar

*Education*—Dalmianagar High English School has got on its roll 500 students and co-education is imparted up to a certain standard. Arrangements are being made for providing separate girls' education for higher classes. Free Primary education is imparted to the boys and girls and a Free Night School is maintained for adults in the Labour Welfare Centre.

*Clubs*—Dalmianagar, at present, has three clubs; Dalmianagar Club Membership is limited to the members of the superior staff. Rohtas Club—well-known as Labour Welfare Centre—is the centre of workers' social activities. There are libraries, kept up-to-date with latest books and periodicals and a free reading room. The clubs are equipped with Radios, Gymnasium and playgrounds and provide all sorts of indoor and outdoor games and thus provide for entertainments, exercise and other popular mediums of social life. Lectures, literary gatherings, frequent staging of dramas, celebrations of festivals form a normal feature of the club activities.

A new addition is the Recreation Club so far patronised by the top ranks.

*Dairy Farm and Goshala*:—A long-felt want of milk supply is being fulfilled by the Dalmianagar Goshala. It is running at present with a few dozen of cows and buffalos but arrangements are completing for a well-managed farm when the requisite number of cattle will be added.

*Canteen*:—There is a Canteen too, working under the guidance of the Indian Tea Market Expansion Board, which serves tea and refreshments inside as well as outside the factories.

*Cinema*:—The Cinema, primarily meant for the residents of Dalmianagar, attracts picture fans from Dehri town and neighbouring villages also. It is being fitted with a Western Electric Equipment.

*Co-operative Stores*:—The employees have recently started a Co-operative Stores registered under the Co-operative Societies Act for the supply of essential day-to-day articles to its members as well as non-members.

*Public Health*:—is looked after by the Health Department under a Health Officer.

*Safety and First Aid*:—There is a Safety Department with a Safety Engineer under a strong Committee of the top-most officers which looks to the prevention of accidents and disposal of accident cases.

There is a First Aid Centre in the factory where cases of minor injuries are attended to immediately.

## HIGH LIGHTS OF PROGRESS

		1934	1939	1947
Authorised Capital	... Rs.	30,00,000	1,00,00,000	5,00,00,000
Subscribed Capital	... Rs.	15,00,000	50,00,000	1,70,00,000
Salaries and Wages disbursed at				
Dalmianagar	... Rs.	3,50,000	10,00,000	50,00,000
Stores Purchase	... Rs.	3,50,000	16,00,000	1,80,00,000
Coal Consumption	... Tons	4,000	90,000	1,20,000
Total area of Land	... Acres	700	320	640
Bungalows and Quarters	... Nos.	20	700	1,500
Employees Welfare Expenditure	... Rs.	15,000	50,000	3,50,000

# NATIONAL LABORATORIES IN BIHAR

*By*

SIR S. S. BHATNAGAR, K.T., O.B.E., D.SC., F.R.S.

Bihar is the richest province in the Indian Union so far as minerals and raw materials are concerned. Coal, iron, mica, manganese, chromite, nickel, copper and lead are some of Nature's gift to Bihar. Asia's biggest iron ore deposit, estimated at 2,832 million tons, and believed to be sufficient to meet India's requirements for a thousand years lies in Bihar and Orissa belt. It is Bihar again which supplies the major portion of coal, and the Jharia coal mines are said to be the best in the country. The raising of coal is an important industry in the province, the annual output being over 15 million tons.

The location of coal in close proximity of iron ore has been one of the chief factors responsible for the establishment of India's iron and steel industry at Jamshedpur. The importance of this would be more fully appreciated when it is stated that the Tata Iron and Steel Works, the world's second largest steel factory, consumes  $1\frac{1}{2}$  million tons of coal annually. Jamshedpur claims some of the richest and most extensive iron mines in the world.

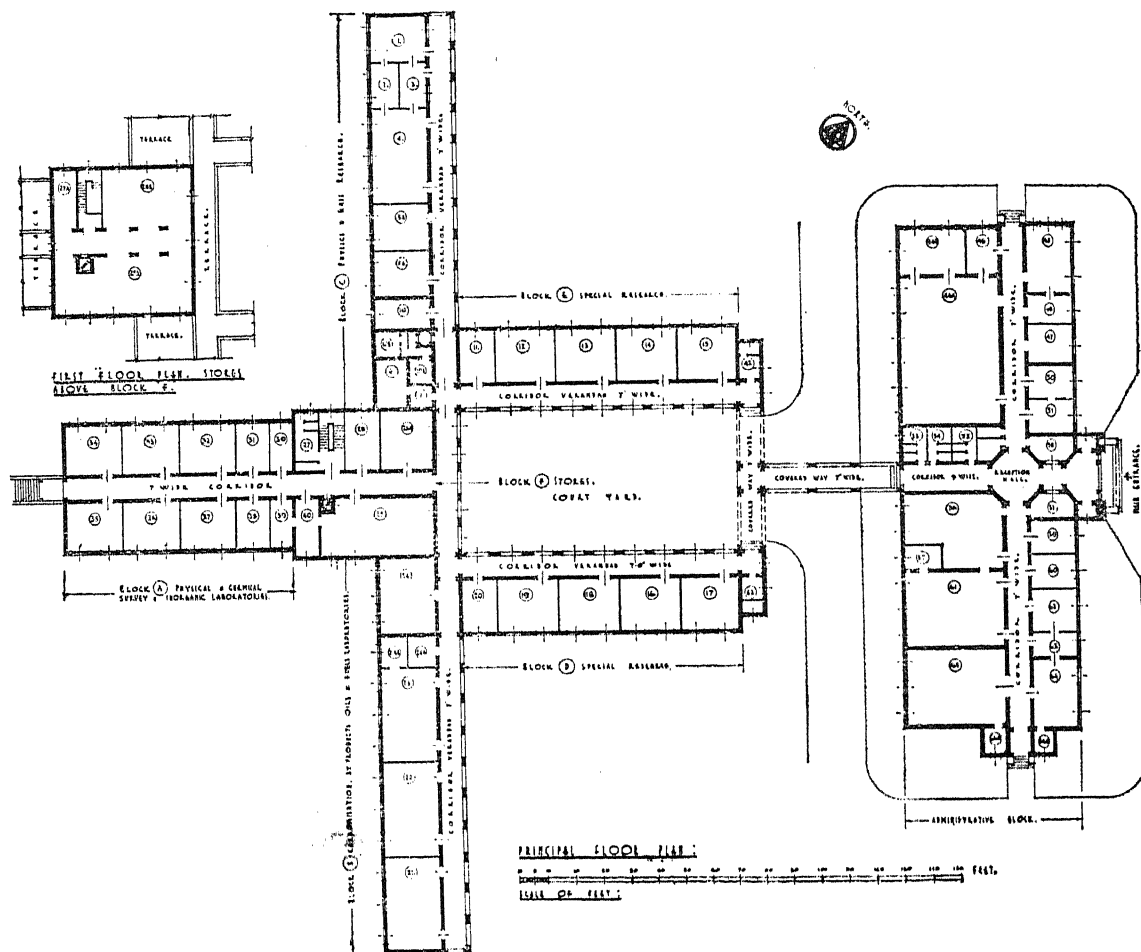
The decision of the Council of Scientific and Industrial Research to locate the National Metallurgical Laboratory and the National Fuel Research Institute in Bihar is a fitting tribute to the importance of the province in the domain of two raw materials so vital to the life of a nation.

## **National Metallurgical Laboratories, Jamshedpur**

Metallurgical industry is a key industry as it is the mainstay of a large number of other industries that are essential for national welfare and progress. The truism that the industrial progress of a country bears a definite proportion to the country's metallurgical industry has now been definitely established.

Recognising the importance of the metallurgical industry and its problems, the Metals Research Committee of the Board of Scientific and Industrial Research came to a considered decision that to ensure the industry's progress and expansion a central organisation in the form of a National Metallurgical Laboratory was essential. This recommendation was accepted by the Council of Scientific and Industrial Research and plans for the establishment of the National Metallurgical Laboratories, at Jamshedpur, as a part of the chain of National Research Institutions throughout the country, were taken in hand.

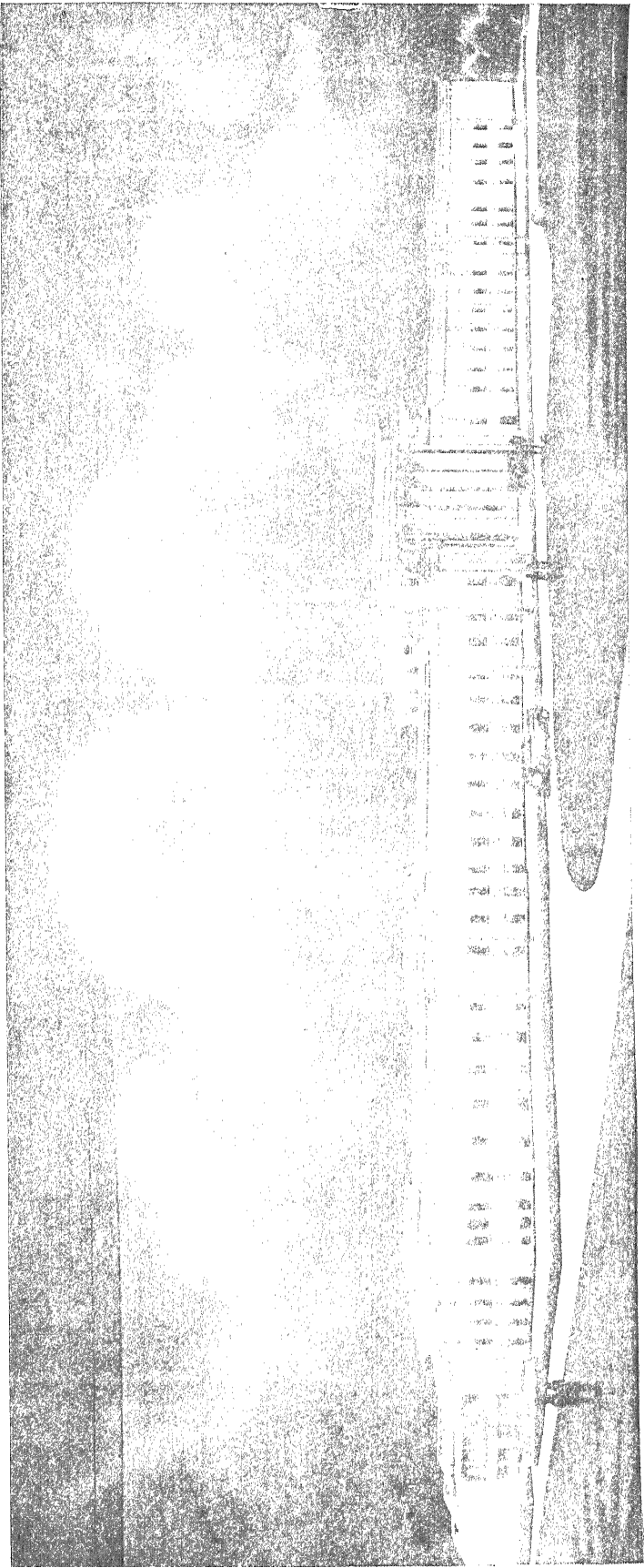
Jamshedpur was chosen for the location of the laboratories in consideration of the numerous facilities offered by this great place. The foremost of these has been the consideration that in the application of fundamental research to metallurgical industry close contact between the research workers and the industry itself is

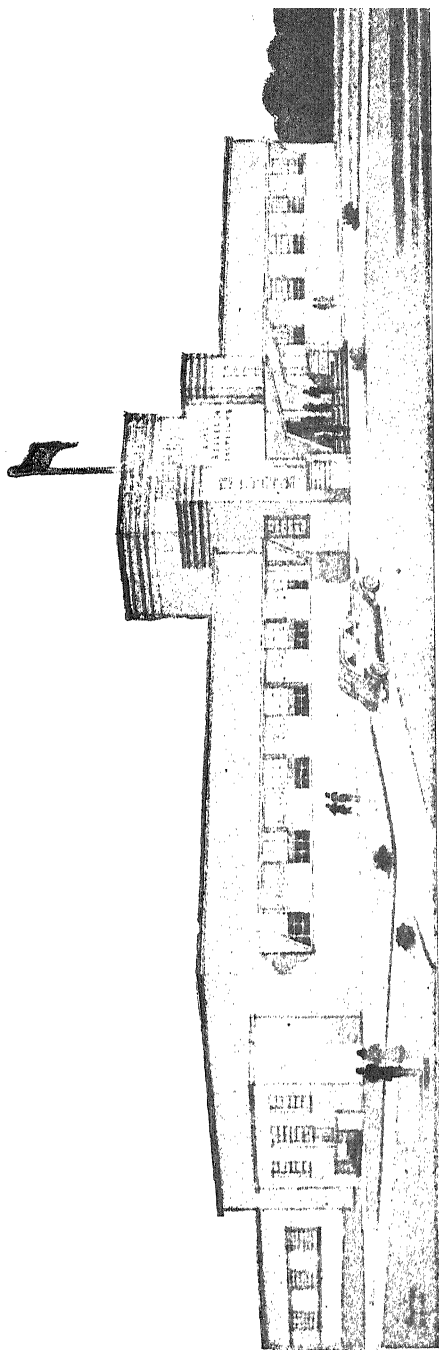


Plan of National Fuel Research Institute, Dhanbad

essential. Jamshedpur is the heart of the Indian Metallurgical Industry and affords excellent facilities for the study of practical operating problems at the works of the Tata Iron & Steel Co., and numerous other concerns nearby. The National Fuel Research Institute at Dhanbad would be close by and intimate collaboration with the Government Metallurgical Inspectorate situated at Jamshedpur and with the Research and Control Laboratories of Tatas that might become possible would be an additional advantage.

The foundation stone of the National Metallurgical Laboratories, was laid on





National Fuel Research Institute, Dhanbad.

the 21st November, 1946, by His Excellency Shri Rajagopalachari, the then Minister for Education and Arts in the Interim National Government.

The Laboratory when completed will cover all aspects of metallurgical research both fundamental and applied. It will also carry out research on ores, minerals and refractories as applied to metallurgy. Arrangements have also been made for work on chemical analysis : Physical Chemistry ; Physics as it affects metallurgical problems ; examination, preparation and smelting of metallic ores ; melting, heating treatment, and working of metals and alloys ; electro-deposition and surface treatment of metals and refractories.

The building and equipment will cost about Rs. 43 lakhs, of which Rs. 12 lakhs has been provided by the Pioneer House of Tatas and Rs. 1 lakh and 10,000 respectively by the Indian Steel Products and the Indian Metallurgical Industries. The recurring expenditure is estimated to amount to Rs. 5 lakhs. The layout fits the site and sufficient space is available for future extensions of both the main laboratory building and the Technological Block.

As the Laboratory will be an All-India centre of metallurgical activities a properly equipped lecture theatre has been provided. A large museum will prove to be of inestimable value to the visiting students and engineers.

### **National Fuel Research Institute, Digwadih-Dhanbad.**

India's iron industry has grown so quickly that she is now the second largest producer of iron ore in the British Empire, yielding place only to the U. K. The iron industry is based on the greatest resources of high grade iron-ore in the world and for all these purposes coal and more coal will be required. That is where the necessity for planning with its scientific and technical research to help in the utilisation and conservation of coal, in the finding of substitute fuel and in such other allied aspects comes in. This necessity will be met by the National Fuel Research Institute, Digwadih-Dhanbad.

The institute is situated at Digwadih 10 miles south of Dhanbad. Here the superior rights of about 150 acres of land were donated to the Council of Scientific and Industrial Research by the Raja of Jharia, Babu Shib Prasad Singha, M. B. E. Digwadih lies roughly half way between Dhanbad to the north and Sindri to the south-east. It is at Sindri that the large synthetic fertilizer plant will be erected in the near future. The institute at Digwadih will thus be a growing industrial area, in the heart of the coal fields and in close proximity to the National Metallurgical Laboratory at Jamshedpur.

It will be the main function of the institute, when completed, to ensure that India's valuable supply of coal is utilised to the best advantage at the same time the properties and uses of all types of fuel will be studied, including petroleum, wood



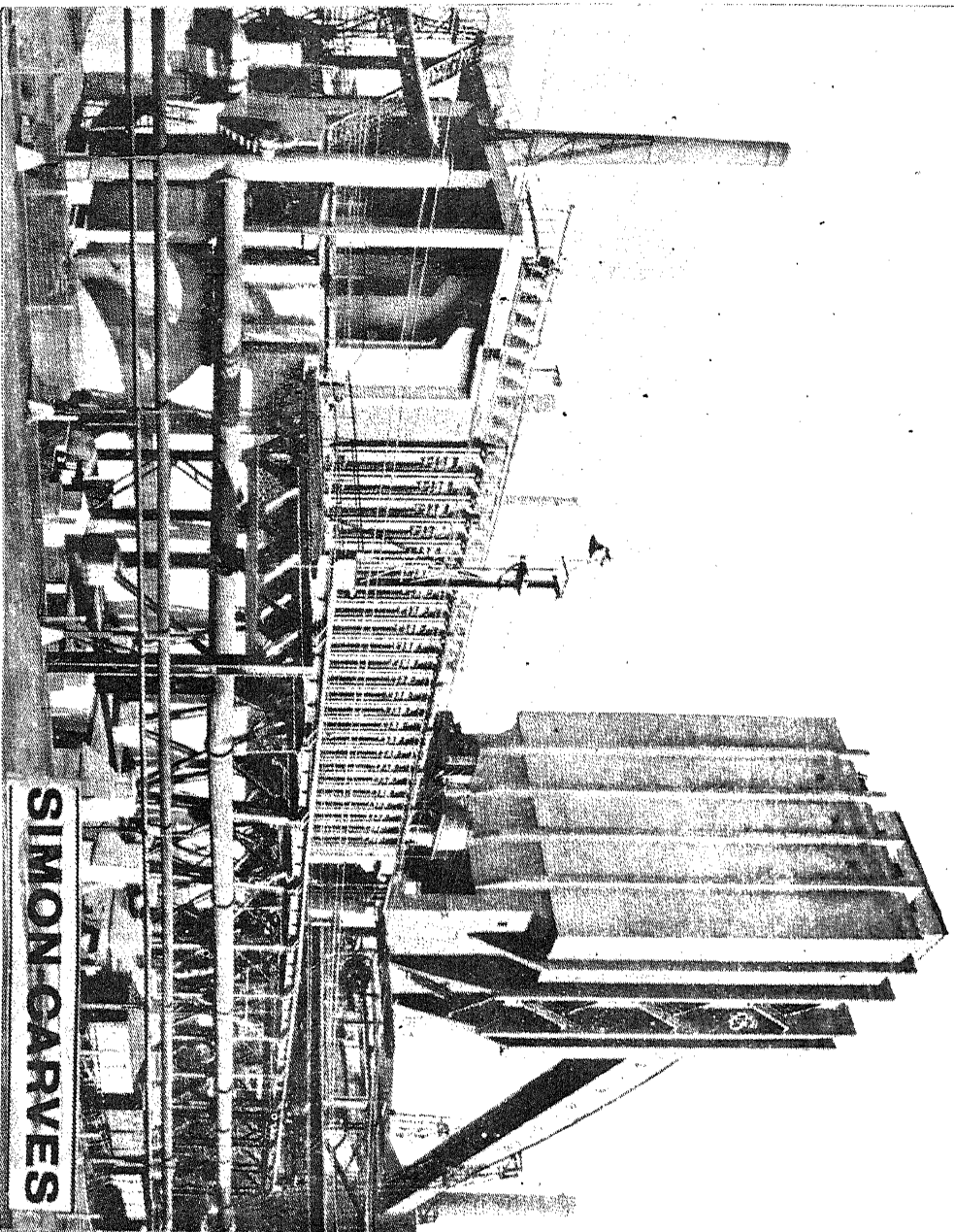
charcoal, alcohol and gaseous fuels. Whether modern coking practice be adopted more extensively or low temperature carbonisation plants should be developed indicates only some of many problems that will be tackled at the institute. A large and active tar distillation industry for the production of dyes, drugs, plastics and explosive, the up grading of coal, briquetting of slack and small coal and many other similar items await development as soon as the institute starts working.

The building and equipment of the institute will cost Rs. 14 lakhs and the recurring expenditure for the first five years will be  $2\frac{1}{2}$  lakhs and subsequently  $5\frac{1}{2}$  lakhs.

In closing this article one cannot but recall the concluding remarks of the Hon'ble Mr. C. H. Bhaba when laying the foundation stone of the National Fuel Research Institute on the 17th November 1946. He said :—

“The *Economist* of London recently observed that while the political future of the world was being decided in Paris, its economic future was going to be decided in Washington. The Scientific future of the world may also be decided in Washington but I have every hope that the Scientific future of coal and therefore of all our leading industries may be decided in Bihar.

I am confident that Bihar, with its past records, will play its rightful part in the promotion of the activities of the institute which is so essential for the welfare and progress of the country”.



## SIMON CARVES

A picture of a coke oven battery showing the ovens and the coal bunker

# \* THE BARAREE COKE WORKS MANBHUM

*By*

S. K. SIRCAR, M.Sc. (CAL), PH.D., A.R.S.M., D.I.C. (LOND.)

Situated in the Kendwadih and Bulliari area about five miles away from Dhanbad Station on the E. I. Rly. line (Grand Cord) in the district of Manbhum, Bihar, Bararee Coke Works stands as an example of industrial enterprise for the scientific treatment of raw coal for manufacturing Hard Metallurgical Coke and recovery of by-products. Since the first production of coke and the recovery of some of the by-products in the year 1921 there have been continuous improvements, additions and alterations to the plant so as to increase the scope of manufacture with respect to the quality and variety of products. Considering the comparatively small size of the plant as a whole, the manner of by-products recovered and the fineness of quality of some of them are large and noteworthy. During the World War No. 2, the Bararee Coke Works kept up invaluable supplies of stores such as Coke; Toluene, Benzol and Benzol products, Black Paints, Disinfectant (Phenyle), Carbolie Acid, Cresylic Acid, Sulphate of Ammonia, Naphthalene, etc. in large quantities. The plant, as it stands to-day, manufactures the following regularly :—

## *Coke.*

Blast Furnace Coke.

Foundry Coke.

Hard Coke Rubble.

Coke breeze

Retort Carbon.

## *Coal Tar and its products.*

Coal Tar 'Bararee Brand'.

Refined Tar.

Road Tar, Nos. 1, 2, and 3 to any specification.

Coal Tar Pitch, to any specification-soft, medium, or hard.

Middle Oil.

Creosote Oil.

Anthracene Oil & Salt.

Naphthalene-pure, refined.

Black Grease for colliery ropes,

Black Paints & Varnish.

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\* The diagrams included in this article were kindly lent by the Mining, Geological & Metallurgical Institute of India,

*Disinfectants-Bararce Brand.*

Black fluids of various grades and R. W. coefficients.  
 White fluid suitable for use with sea or brackish water.  
 Carbolic and Cresylic Acids (crude).  
 Carbolic and Cresylic Acids (refined).

*Motor Spirit, Organic Solvents and Basic Products.*

Motor Benzole.  
 Benzene-various grades up to pure caystallisable.  
 Toluene-various grades up to pure.  
 Solvent Naphtha-refined and refined lead-free.  
 Heavy Naphtha.  
 Xylene.

*Inorganic Products; Heavy Chemicals.*

Ammonium Sulphate (neutral).  
 Sulphuric Acid (R. O. V.), sp. gravity 1.840.  
 Sulphuric Acid (B. O. V.), sp. gravity 1.700.

*Insecticides :—*

Barcol—D. D. T. Emulsion Concentrate.  
 Barsol—D. D. T. Wettable Power.

The Factory is comprised of a Battery of 35 Simon Carves' Horizontal Flue Waste Heat Type Coke Ovens, a Sulphate of Ammonia Recovery Plant (Direct Type), a Benzol Plant, a Tar Distillation Plant, a Tar Acids Plant (Leonard Monsanto Vanadium Catalyst Type), a Tar Acids Recovery Plant. plants for manufacturing high class Disinfectants. Black Paints, a plant for recovering and refining Naphthalene, and a plant for manufacturing D. D. T. Emulsion Concentrate.

Like other Coke Oven Plants the operations here are going on in a cycle of continuous technical process. Coal is received from the collieries in the field at the Siding of the Company and after unloading the wagons elevated to the top of a Bunker where it is stored after fine crushing to be drawn out through the bottom into small coal charging Larries for charging individual ovens through the top over which the Larries run.

After charging the ovens, all the openings except one on the top for carrying away gas and products of distillation, are closed and distillation starts due to the heating of the ovens by burning gas in the flues in the walls of the ovens on either side. The products of combustion of the gas used for heating are eventually drawn away by the Chimney through Water Tube Boilers where steam for the whole works is raised by extracting the heat in the gas ; that is why this type of ovens



is known as Waste Heat Type. The distillation of coal in the ovens starts as the charge is heated more and more by the hot side walls, gases and other products of distillation; tar, ammonia, etc. escape through vertical pipes (Ascension Pipe) into the gas collecting Main (to which the Ascension pipes of all the ovens are connected) in which due to the continuous circulation of comparatively cold tar, part of the tar vapour condenses. The tar and gases flow onwards towards the next Recovery Plant namely the Sulphate of ammonia Plant. During this passage all condensed tar is removed and any tar fog remaining in the gas is eliminated and reduced to a minimum by the Cyclone Precipitator and the Tar Extractor where the use of liquor in form of sprays helps the cleaning of gas. The gas free tar and tar fog is drawn away by a Turbo Exhauster and made to bubble through a bath of Sulphuric Acid in the Ammonia Saturator. The strength of acid in the bath is so adjusted that continuous formation of Ammonium Sulphate and its precipitation in form of crystals go on due to the reaction of Ammonia in the gas with the Sulphuric Acid in the bath. After bubbling through the bath and the removal of its Ammonia content, the gas escapes through the top of the Saturator and pushed onwards by the Exhauster in its course towards the Benzol Plant. Because the Ammonia is recovered in form of Ammonium Sulphate by bringing the gas directly in contact with the Sulphuric Acid the process is known to be a Direct Process of recovery. Ammonium Sulphate crystals are continuously removed from the Saturator as they are formed by an Ejector and after removal of the associated liquor by settlement in draining tables and finally centrifusing is eventually neutralised and dried in a Steam Heated Drier, and is ready for the market after bagging.

The gas after leaving the Ammonia Saturator is adequately cooled in a Serpentine Cooler so as to remove most of its naphthalene content and pass through a series of Benzol Scrubbers in a counter current direction to a continuous flow of Absorbing Oil,—Creosote in this case. The oil removes benzol vapour by coming in intimate contact with the gas and absorbing it due to the difference of vapour pressure of benzol in oil and the gas. After removal of the benzol the gas is sent back to the ovens where it is used for heating. The benzolized oil, i.e., the oil after absorbing Benzole is continuously passed through a distillation still for distilling off crude benzol and the de-benzolised oil left is cooled and sent back to circulation for absorbing benzol over and over again. The Crude Benzol produced is distilled in batch stills to produce a few rough fractions such as Once-run-Benzol, Crude Naphtha, etc. The end product left in the still or the still bottom is partly naphthalene and partly absorbing oil. Once-run-Benzol is further refined by washing with concentrated sulphuric acid and caustic soda and finally distilled in batch stills with suitable fractionating columns,—the products of distillation conforming to various specifications, distillation range and degree of purity, as required from time to time. The installation at the Bararee Coke Works is capable of manufacturing such refined products of a high degree of purity as pure

toluene for nitration, benzene and xylene besides motor benzol, solvent naphtha, light solvent naphtha, heavy solvent naphtha, etc.

*Tar Plant* :—Tar produced by the Coke ovens at the works as well as tars received from outside are distilled in pot stills in batches and the products of distillation are middle oil, creosote oil, anthracene oil and salt, naphthalene, pitch and road tar of various grades. Crude Tar Acids are recovered from the oils by treatment with caustic soda and reaction of the sodium salt so produced with sulphuric acid. The crude tar acids produced are eventually turned into finished products such as carbolic acid by various treatments and fractional distillation. Black Disinfectant fluid with a high R. W. co-efficient is also manufactured from the oil and tested in the Bacteriological Laboratory at the Works before release to the market. Black Paints of various types with a pitch base are also manufactured here. The D. D. T. Plant is also a part of the Tar Plant. An emulsion concentrate containing 25% technical D. D. T. and readily miscible with water can be manufactured here in very large quantities.

*Naphthalene Plant* :—The Naphthalene Plant is quite small in size and consists of a Hydraulic Press, a Washer, a Distillation Still and a Tablet Machine. Crude Naphthalene after the removal of oil in a Hydraulic press is purified by washing with sulphuric acid and caustic soda in the washer and final distillation in a batch still. The refined naphthalene so obtained is made into tablets with a Tablet Machine of the rotary type.

*Sulphuric Acid Plant* :—The old Chamber Plant, originally installed, has been replaced by a Contact process Plant of the latest type for manufacturing sulphuric acid by bringing sulphur dioxide gas and oxygen in contact with a mass of catalyst,—Vanadium Pentoxide in this case. It is an American Plant producing 10 tons of concentrated sulphuric acid (98.5% strength) per day. It consists of a Sulphur Melter, Sulphur Burner, Gas Coolers, Converter,  $\text{SO}_3$  Cooler, Drying Tower, Absorber Tower, Storage Tanks, etc. Sulphur melted in a tank by steam is pumped into the sulphur burner through the top where by coming in contact with a hot checker work and dry air, is burnt and oxidised to  $\text{SO}_2$  gas,—dry air being supplied by a blower drawing the incoming air through the drying tower where it is dried by coming in contact with concentrated acid being circulated through the top.  $\text{SO}_3$  gas together with excess of air and oxygen is then made to pass through beds of vanadium pentoxide catalyst in two stages and thereby changed to  $\text{SO}_3$  gas which after cooling is made to pass up through the absorbing tower where concentrated sulphuric acid is being constantly fed through the top. The gas is absorbed by the acid whose strength and volume are thereby increased. The increased quantity of acid produced is constantly removed to storage tank as it accumulates in the system.

The capacity to produce iron and steel is an important index to the industrial

position of a country. The manufacture of these important basic materials, as is well known, depends largely on coal and hard metallurgical coke produced from the former. Metallurgical coke as required by the iron makers; metallurgists and important industries such as synthetic ammonia, dry ice, sugar, synthetic motor fuel etc. can be manufactured only from Caking coal of suitable quality. A caking coal when heated in the absence of air to a temperature of 900°C or more gives out part of its volatile matter in form of gas, tar and liquor and the residue left is a shining grey, coherent and fairly dense mass of carbon and mineral matter contained in the original coal, commonly called hard coke, because of its strength and hardness.

India is not fortunate enough in having very large resources of good caking coal suitable for metallurgical purposes. Most of the hitherto discovered deposits of coal of this quality are confined to the Province of Bihar. In early days, when coke used to be manufactured in country ovens and in Beehive ovens (some are to be seen in Bihar), no attempt was made to recover the by-products lost. The value of these products so wasted and their bearing on the industrial development of a country and its national resources was soon realised and by the co-operation, skill and untiring efforts of technicians, scientists and capital rapid strides were made to bring the by-product coking industry to a stage of development when it could be well considered as one of the marvels of modern science and technology. The industry as it stands to-day is in a very high stage of technical and industrial development and yet it has by no means reached the end. India has not lagged behind in this respect but her effort is very insignificant as compared to other advanced countries. Bararee Coke Works is only a small example of such industrial development in India but nevertheless the recovery and manufacture of such a large variety of by-products from such a small plant is by no means a small achievement.

Generally speaking caking coals used for manufacturing coke in India will on an average produce per ton of coal:

Coke	...	14 cwts or 70%.
Crude Tar	...	5 gals.
Sulphate of Ammonia		28.5 lbs.
Benzole (rectified)		1 gallon



# HIGHER EDUCATION IN BIHAR

*By*

R. C. RAY, D.Sc., F.R.I.C., F.I.I.Sc., F.N.I.

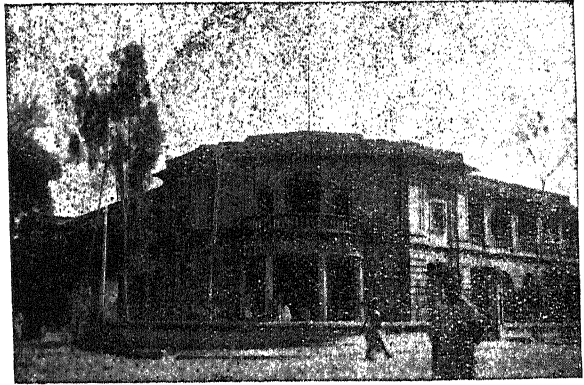
*What sculpture is to a block of marble, higher education is to the human soul. The philosopher, the saint, the hero, the wise and the good, very often, lie hid and concealed in a plebeian, which a proper education might have disinterred and brought to light.—*

*Addison.*

Higher education in Bihar received a strong impetus when Bihar and Orissa were constituted into a separate province by the Royal proclamation at Delhi in 1911. As long as Bihar was attached to Bengal, there was only one college in Bihar, the Patna College, which was maintained by Government. Patna, being then merely a divisional town, did not naturally receive the same amount of attention as the presidency city of Calcutta, and Government help was lavished on the Presidency College of Calcutta to the detriment of other Government Colleges. With the advancement of knowledge and science, the need for expansion of higher education was strongly felt in Bihar, and the demand for the establishment of a separate University at Patna became insistent. The necessity to have a University for advancing learning, developing culture, cultivating science and fostering arts became an acknowledged fact. A university of its own was indispensable for Bihar to have a thorough scientific training for making commercial exploitation of mineral and agricultural wealth of the province possible and to develop various branches of education for the renaissance of the ancient culture of the country. An important step towards the achievement of these objectives and development of higher education was the establishment of a separate university at Patna in 1917.

When the Patna University was first inaugurated, it possessed only six colleges in the whole of Bihar and Orissa, teaching up to the degree examination in either Arts or Science or both, and one institution giving instructions only up to the Intermediate standard in Arts. Besides these, there was also a Law College and a Training College for teachers. Before 1912, there was no provision for postgraduate teaching in any subject excepting history which was taught in the Patna College. This College, the first educational institution in Bihar was affiliated to the Calcutta University in the usual Arts subjects up to

the B. A. Honours standard and in Physics, Chemistry and Mathematics up to the Honours B. Sc. degree. The Bihar National College at Patna, the Greer Bhumihar Brahmin College at Muzaffarpur, the Tej Narayan Jubilee College at Bhagalpur and the St. Columba's College at Hazaribagh were the other first grade colleges in Bihar. The Diamond Jubilee College of Monghyr was affiliated up to the Intermediate standard in Arts, and the Ravenshaw College was the only institution for higher teaching in Orissa. The establishment of the university created the immediate necessity for increasing the very limited facilities for post-graduate studies which had existed previously and a scheme



The Bihar National College

for establishing M. A. and M. Sc. classes in English, History, Economics, the classical languages, Sanskrit, Persian and Arabic, Mathematics, Physics and Chemistry was approved by the Senate of the Patna University in December, 1918, and the teaching commenced in the Patna College from July, 1919.

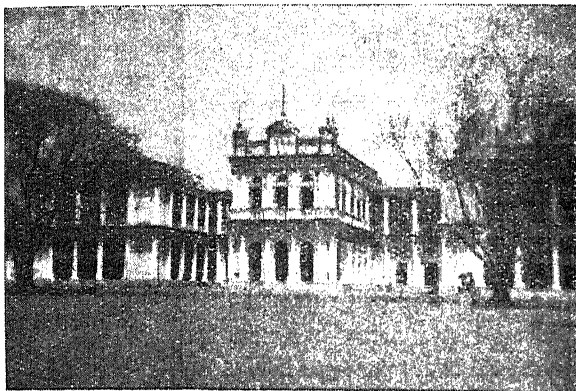
The oldest institution for imparting higher collegiate education and development of knowledge in Bihar is the Patna College. It has been the mother of most of the important colleges at Patna. It has given birth to the Law College, the Engineering College and the Science College. Like all unicellular organisms which develop and then propagate by fission, the Patna Collegiate School, the Law College, the Bihar School of Engineering and the Science College split off from the parent cell to set up a new cycle of generation. It is interesting to find



Patna College

how from a humble seed planted several years ago, so many institutions have grown until by bifurcation, reproduction, transplantation, grafting and other processes known to biology, a vast cultivated garden of learning has emerged,

and Bihar has become one of the important educational centres in India. When the different colleges developed out of the Patna College, the latter became a more homogeneous institution; since then its progress has been marked by internal consolidation and expansion of activities in diverse ways, and adjustment to the changing conditions of the country. There is now a wider range of subjects, and diverse combinations are available to suit the convenience of students. Adequate provision exists for the teaching of geography, both at the Intermediate and Degree stages and there is a proposal to introduce post-graduate studies in this subject soon. Experimental Psychology is another subject



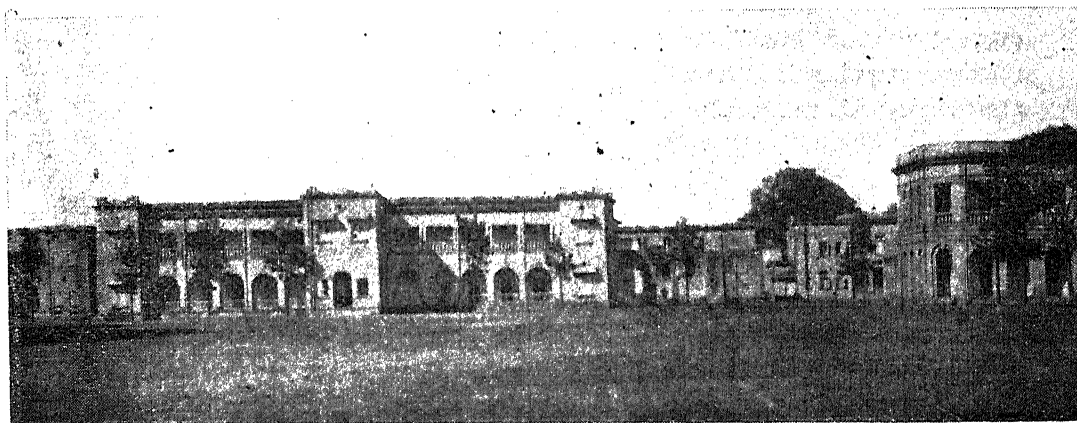
Patna College

which has been added more recently and is taught from the degree stage upwards. Patna College possesses a splendid library containing over 20,000 books and the students have a wide choice of reading. The intellectual and extra-curricular life of the college centres mainly round its four hostels and the large number of societies, such as the Debating, the Archaeological, the Historical, the Chanakya, the Philosophical, the Geographical, the Photographic and Fine Arts societies as well as the English Association. Lectures on subjects of General Knowledge are delivered by members of the staff, and occasionally interesting and instructive trips are undertaken under auspices of one or other of the societies.

The study of engineering is of great importance for proper development of free India. In Bihar, great dams have to be constructed, water-power tapped, means of generating cheap electricity devised, and mineral resources of the province exploited. All these will require a large number of engineers in Bihar as well as in other parts of India. It is therefore essential to provide a fully equipped institution to prepare students in that field. When the Bihar School of Engineering formed a part of the Patna College, it used to train Overseers and Sub-overseers for the Public Works Department and other local bodies, and the course of studies extended from two to four years after the Matriculation stage. In 1909, the Bihar School of Engineering became a separate institution, and in 1923, the School was raised to the status of a college and became affiliated to the Patna University for preparing students for the B. Sc. degree in civil engineering. The first batch of degree students was admitted in 1924, and a course for training mechanical apprentices was started in the same year. Thus there were two additional courses, namely, the Subordinate Engineering and the Mechanical

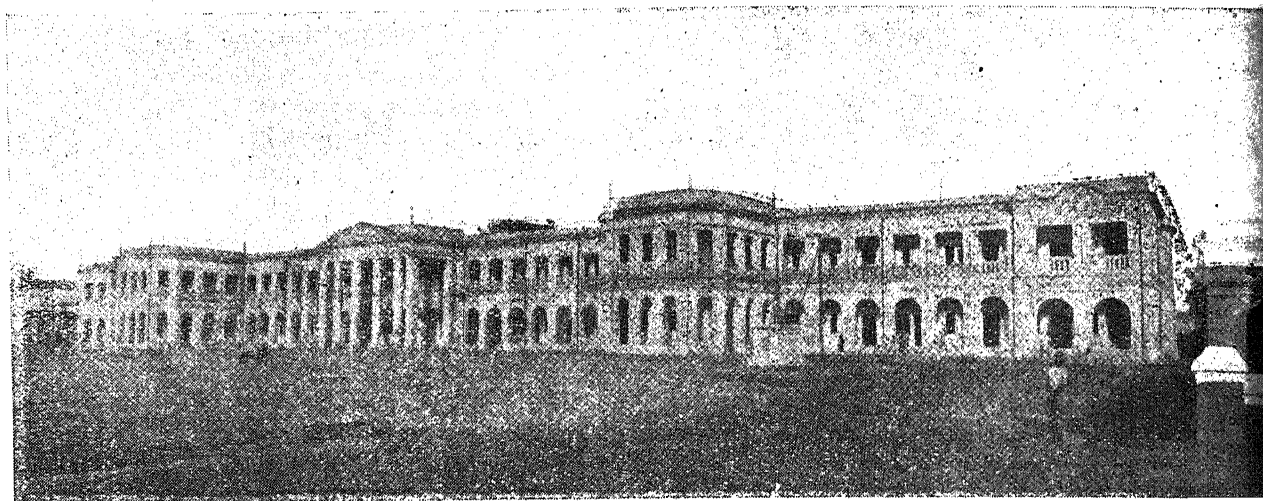
Apprentice, besides the Decree course. In 1930, the Mechanical Apprentice classes were abolished and an Industrial Diploma course introduced instead. For over twenty years the Bihar Engineering College taught only Civil Engineering, but quite recently a degree course in Electrical Engineering has been opened, and students desiring to be electrical engineers need no longer go outside. It is also proposed to add a degree course in Mechanical Engineering at an early date. The Engineering College possesses fully fitted and efficiently worked workshops.

When Bihar and Orissa were joined together and made into a separate province the need for a Medical College was keenly felt, but as it was not possible to start a Medical College at once, arrangements were made with the Government of Bengal to reserve 18 seats in the Calcutta Medical College for the students of the newly created province. The arrangement was inadequate to meet the growing need of the students who were increasing by leaps and bounds as one year passed into another. The Prince of Wales Medical College was



The Prince of Wales Medical College

admitted to the Patna University in 1925 and its medical degrees were recognised by the British Medical Council in 1935. The college is situated on extensive grounds and is provided with large anatomical and pathological museums, well arranged laboratories, convenient lecture theatres, and a big hall which may be used for a variety of purposes. The attached hospitals are all well equipped, having most modern appliances and conveniences. As in the case of all colleges in the province, the college has well-built hostels for students as well as a fine library. There is also a well-kept Animal House, looked after by a specially trained animal keeper. The Bacteriophage Laboratory is a unique institution where researches on bacteriophage and intestinal organisms are being carried out systematically. A large quantity of different kinds of phages is prepared



The Prince of Wales Medical College

every year and issued from this laboratory. These are used throughout the province by public health workers and in the hospitals, and large quantities are also sent outside the province.

It has often been stated that India is a rich country with poor citizens, and Bihar is not an exception to this statement. The poverty is to a large extent due to the ignorance and indolence of the people. They are too lazy to keep their living houses clean and they do not know what food is essential for the maintenance of their health, and what vegetables and fruits are rich in vitamins and minerals. With a view to make the people food-conscious, the nutrition scheme as a unit under the Public Health Department was started, and the unit is carrying out dietary and nutrition survey of sections of population belonging to different social, economic, racial and communal groups. In the nutrition laboratory, a methodical assay as to the nutritive value of various items of foodstuff not so far examined is being made. The biological value of different proteins is also being worked out.

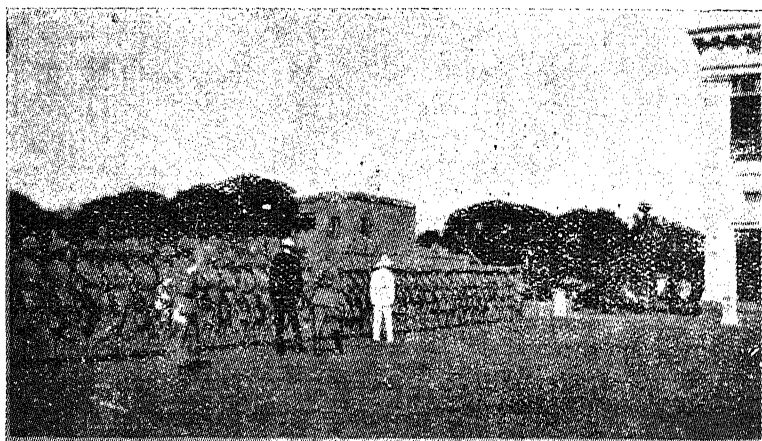
The demand for properly qualified medical men is so great that the Prince of Wales Medical College proved incapable of training the necessary number. The growing insistence for greater facilities of medical education has led to the establishment of another Medical College at Darbhanga in 1946, the existing Medical School having been converted into a college. The two medical colleges will be able to produce together over 100 medical graduates every year.

Just as the health of the people is of great importance to the nation, so also the possession of good cattle and other animals is one of its valuable assets,

The deterioration of the Indian cattle is the chief cause of insufficiency of milk supply which is at the root of increasing child-mortality and growing incidence of tuberculosis in the country. Healthy children only can become a vigorous nation. The health of the livestock is the most important factor in the production of the food of the nation. In order to investigate the animal diseases prevalent in the province, the Government of Bihar and Orissa decided, in 1925, to start a Veterinary College at Patna. The college was opened in July 1930 under the name of Bihar and Orissa Veterinary College. The name was later changed into Bihar Veterinary College in 1936-7, because of the separation of Orissa from Bihar. The College is situated nearly 7 miles away from the heart of the town, on extensive grounds open on all sides, with sufficient space for future extension. The laboratories and hospitals are well-equipped on modern lines and give sufficient scope for practical work and research. Adjacent to the college is the Government Cattle Breeding and Dairy Farm which affords students opportunity of learning animal husbandry. At present the college provides a three years' Diploma course with an examination at the end of each year. Students who pass the final examination are awarded a Diploma which entitles them to undertake private practice or employment as Veterinary Assistant Surgeons and excellent results have attracted students from all over India. The college hospital has made itself popular by rendering free aid to a large number of poor villagers' cattle. Up-to-date lines of treatment are also provided for dogs and horses. The research laboratory has been doing important work on bovine and equine diseases, in addition to the routine examination of blood smears, pus, urine, faeces, skin scrapings, milk, brain and other things received from different districts of the province. Since 1940, this laboratory has commenced to manufacture rinderpest virus which is supplied to members of the veterinary staff in the province for immunization of cattle. It is now high time that the college should start training students for a degree course in veterinary science and for this purpose the institution should be affiliated to the Patna University.

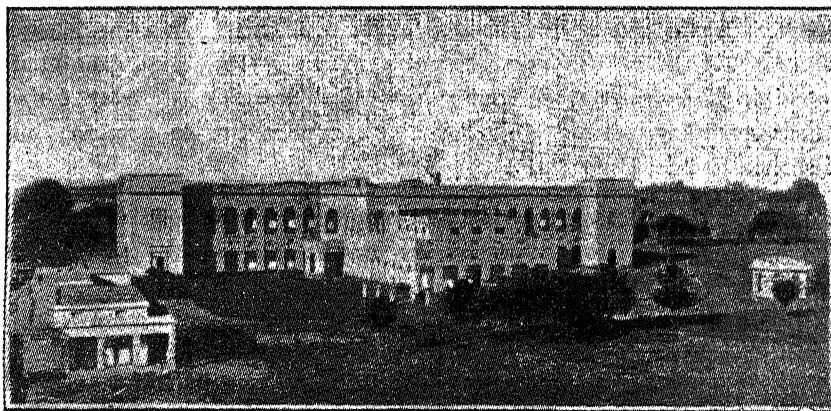
It would be banal to say that the modern age is the age of science. Scientific education is necessary for increasing the health and wealth of the people and for raising the standard of their living. The birth of the Science College therefore is an important milestone on the path of progress of higher education in the province. Science classes, so long attached to Patna College, moved to a group of new buildings in July 1927, and the Patna Science College was formerly opened by the Viceroy, Lord Irwin, in 1928. Over ten lacs of rupees have been spent in the construction of the college, and the buildings are the finest of their kind in the province and better than those in many other provinces in India. Eminent scientists, like Sir P. C. Ray, said that the arrangement of the laboratories is the finest in Asia. They are, at least, reputed to be some of the best in India. The Science College comprises 5 main buildings, without counting the

gas house, radio-activity block and other outhouses. Physics and Chemistry are each housed in a large self-contained block, each department possessing a well-equipped workshop of its own. A third block of two-storied building accommodates the departments of English, Mathematics, the general library and the administrative offices. A fourth block contains a gymnasium downstairs and



Lord Irwin inspecting guard of honour on the foundation day of the Patna Science College.

the Students' Common Room on the upper floor. The front of this building is provided with a balcony and tiers of seats which serve as an amphitheatre for watching matches and sports. The staff room in the Administrative Block serves, when necessary, as the general Common Room for the professors, and it is also



Physics Laboratory, Patna Science College.

used in the evenings as the staff club. A fifth block has been added to the existing group of buildings more recently for the Biology Department which teaches Zoology and Botany up to the degree stage. Schemes have been prepared for the extension of the Physics laboratory to teach Applied Physics in the

post-graduate classes, and extension of the existing Biological laboratory for opening M. Sc. classes in Botany and Zoology and for providing laboratories for the teaching of Geology up to the highest stage. These schemes are in active consideration of Government and are likely to be given effect to in the near future.

The various societies of the college, such as the Bazm-e-Sokhan, Hindi Literary Society, Bengali Literary Society, Biological Society, Chemical Society, Physical Society, Photographic Society, Maithili Society and the Debating Society as well as the Athletic Club, provide the students of the college with sufficient extra-curricular activities. Besides these societies, there exist in the college, the Army Information Bureau, Mass Literary Committee, Poor Boys' Aids Committee, Old Boys' Association, University Training Corps and the First Aid Training Centre. Thus the students do not confine themselves to their own particular groove of thought, but familiarize themselves with other related intellectual and physical activities as well as world affairs. It is realised that true education consists in a contact of mind with different minds, and the greater the chances of such a contact the more liberal is the education which is acquired.

In 1930 a society named the Patna Science College Philosophical Society was started with the main object of encouraging and co-ordinating scientific investigations. Its membership is open to all teachers of science belonging to any of the colleges affiliated to the Patna University. The Society publishes an annual bulletin in which the results of all researches carried out during the year by the members are collected and published. A glance through the bulletins of the Society reveals that despite the fact that members of the staff of the Science College are engaged mainly in purveying for Intermediate and Undergraduate students, they have made some important contributions to science. Researches in mathematics are chiefly on problems of pure mathematics. Investigations on physical problems have been directed to miscellaneous topics, but some of the principal lines of work have been on spectroscopy, Raman shifts, x-ray investigations, radio waves, viscosity and dielectric measurements. In Chemistry research has centred round the chemistry of boron and silicon, hydrides of metals, formation of complex compounds, adsorption, colloids and action of light on chemical reactions as well as on cyanine dyes and sensitization and dyes derived from acenaphthene and anthraquinone. On the industrial side, an electrical method for the clarification of cane juice has been worked out and the process has been patented. Several methods for the utilization of waste mica in Bihar have been successfully discovered and patented.

Unemployment and under-employment are increasing and the average student finds it difficult to cope with the problem of earning his daily bread without a training in science, since Intermediate Science is the entrance examination for medical, engineering, technical and professional studies. It is, therefore, natural



that the number of students reading science would increase rapidly ; consequently there is a heavy demand for seats in the undergraduate classes of the Science College. It should be mentioned that Science College is the only institution in the province where postgraduate teaching and research work in science are carried on.

The Patna College and the Science College are the two premier colleges in Bihar maintained by Government for Arts and Science teaching respectively. These institutions prepare students from the Intermediate to the Post-graduate stages and are also expected to carry on researches. By the growing clamour for admission, these institutions have arrived at the cross-road. It is time to decide, once for all, whether or not undergraduate teaching should be separated from higher teaching and research, and these institutions should confine their attention only to the latter. It must be remembered that Intermediate teaching is entirely different in nature from higher teaching. Democracy as applied to art, to science or to literature is mischievous. It is necessary to differentiate between the education required for the ordinary person possessing average ability and people who have exceptional talents. In education mass production is very well for the mass, but it does not suit the genius. A system of education, which is highly efficient for the mass and enables the mass to acquire a great amount of learning in the minimum of time, may be very convenient, but is bad for the men of genius and very bad for the nation that adopts it. The aim of the university should be to create an aristocracy of learning. In speaking of aristocracy and democracy of learning there is, of course, no question of the rich or poor. Those who are rich in mind form "the aristocracy of learning"; and it is quite independent of the financial resources of the students or their parents. Genius is as likely to be found among the poor as among the rich, but it will be found in a very few. A good general education will not produce genius, and one fault of the present system of education is that it is designed almost exclusively for the benefit of the mass and does not give sufficient scope for the genius to emerge out of the crowd. There is no doubt that the mass is entitled to the best education, but the whole structure for imparting education should not be built on the theory that all are entitled to the same education and are equally able to profit by it. In the present system of education, there is far too great a tendency to attempt uniformity in education, to lop off the tall ears of corn and bring them down to the same level. If we start with the teaching of fifty children, we might hope only one of them will be fit for higher studies. From a large number of such units we might expect, here and there, a Langmuir or Lewis, a Thomson or Rutherford, a Moureu or Sabatier, a Fisher or Kekule, a Raman or Saha, even a Newton or an Einstein. For these we do not want a system of education adopted to the great mass of the population, nine-tenths of whom are by nature not fitted to become musicians, writers, painters, or scientists. It is a small proportion of mankind which is capable of contributing largely to human knowledge. The highest education

is wasted on all but the few, and this statement seems to be true of all classes. On the other hand, the exceptional men of genius return a thousand-fold the time and money spent on their education. One such man is worth more than a very large number of men of average ability. *Ne e quovis ligno Mercurius fiat* ; it is not every piece of wood that you can carve into a statue.

The period between 1938 and 1946 is characterized by remarkable expansion of educational facilities in Bihar. During this period, as many as nine colleges were started and affiliated to the Patna University. Rajendra (Chapra) and Chandradhari Mithila (Darbhanga) Colleges were admitted to the Intermediate standard in Arts with effect from the session 1938-9. In 1940, Rajendra College was raised to the status of a first-grade college and in 1942 Chandradhari Mithila College was also raised to the B.A. standard. It was also admitted to teach courses in Certificate in Commerce and up to Intermediate standard in Science. Ramkrishna College at Madhubani was admitted to teach up to the I.A. standard, the D.A.V. College at Siwan up to the Intermediate standard in Arts and Commerce, and the Marwari College at Bhagalpur up to I.Com. standard. In 1942, Har Prasad Das Jain College was opened at Arrah and was permitted to prepare students for the pass B.A. examination, and for the I.Com. in 1943. In 1944, the Sachchidananda Sinha College at Aurangabad has been admitted up to the I.A. standard and the Gaya College up to the B.A. and I.Com. standards. Then there are the St. Xavier's College at Ranchi and the Ganesh Dutt College at Begusarai. St. Columba's College, one of the oldest colleges in Bihar, has opened B.Sc. classes in 1946, and St. Xavier's College, the youngest college, has been growing vigorously. It has recently moved into a spacious three-storied building and has the unique distinction of being the first college in Bihar teaching geology up to the B.Sc. degree.

Besides geology, agriculture is an important subject of study for Bihar, which is mainly an agricultural country, possessing large tracts of valuable soil. It has been proved beyond doubt that India must produce more food in order to feed her teeming millions, and the land must be made more fertile to grow better and larger crops. It is in the fitness of things, therefore, that during the fecund period of educational expansion of the province, a College of Agriculture has been established at Sabour. The college prepares students for the B.Sc. degree in Agriculture and is affiliated to the Patna University. In a short time, the first batch of students of the College will go up for the final examination.

For a long time there was no separate Women's College in Bihar, and women students had to compete with men for admission into the colleges. Women students who wished to read Arts generally took admission in the Patna College and those desiring to study Science went to the Science College. This course was right as long as the pressure on accommodation of these colleges was not

so great. The need for a separate women's college in Bihar was keenly felt. The Patna Women's College, established by the Carmelite sisters, removed this want to some extent. In 1941-42, this college was elevated to the B.A. standard with facilities for the study of Honours in some subjects. With the establishment of a college separate for women students, the increase in their number is simply amazing. In the I.A. examination of 1943, one of the students of this college secured the first place in the Patna University, an unprecedented event in the history of the University, and the performance was repeated in 1947. It was soon found, however, that one college for women is too few to meet the need of the ever-increasing number of women students. To satisfy the public demand for more colleges for women, Bihar Government was forced to establish a degree college for women. This college, which is, at present, housed in residential quarters, has no provision for scientific training. With growing demand for women doctors a fully equipped institution for the teaching of science should be got up for girls. Under the present structure of the Indian society, separate institutions of the teaching of girls and women are necessary. A separate training college for women teaching up to the M. Ed. degree may also be required soon.

It will be seen that the foundation of a University at Patna has substantially contributed to the rapid educational advancement of the province. During the short period of thirty years of its existence, the University of Patna may claim to have established its reputation as an institution which has developed rapidly, maintaining a high standard in its examinations. In 1917, when the University came in existence, the number of students was 2575, but in 25 years the number rose to three-and-half times of this figure. The University has founded 15 research scholarships, four of which are allotted to the Faculty of Arts, five to the Faculty of Science, two to the Faculty of Medicine, two to the Faculty of Engineering, one to the Faculty of Education, and one floating, which is awarded according to demand. The value of each of these scholarships has been fixed at Rs. 100/- a month. The scholars are expected to work under the guidance of a senior professor for a period of two or three years, after which they are eligible to research fellowships. Before a research scholar is, however, promoted to the rank of a Research Fellow, he is required to secure the degree of Ph. D. of the Patna University on the basis of the research work previously done by him as a research scholar. The value of a research fellowship is Rs. 150/- per month. The University has also instituted 3 series of Readership lectures—one in Indian Economics, one in Natural Science, and one in Hindi. Eminent professors from all parts of India are invited to deliver these lectures.

The object of university education does not consist in teaching people to know what they do not know; its aim should be to teach them rather how to

think than what to think, so as to enable them to think for themselves, than to load the memory with the thoughts of other men. A little more than fifty years ago Froude wrote: "The knowledge which a man can use is the only real knowledge, the only knowledge which has life and growth in it, and converts it into practical power. The rest hangs like dust about his brain, or dries like rain-drops on stones". In visualizing any system of higher education, it is essential to avoid falling into the pernicious idea that mind is a warehouse, and education but a process of stuffing it full of goods. The aim of the University should be to convert the mind of the student into a living fountain and not a reservoir. That which is filled by merely pumping in will be emptied by pumping out. The mind of the university-trained pupil should be a thing that works. It should be able to pass judgement on events as they arise and make decisions. A true university education must be inventive-minded. It should believe so profoundly in the high value of the inventive or the creative spirit that it will set itself to develop that spirit by all means within its powers.

The proposal for establishing a teaching university at Patna is hanging fire for the last ten years. The authorities have not yet been able to come to a decision in this regard. There is also a scheme of splitting up the University into four different universities. While these schemes and counter-proposals are under consideration, the University has set up two departments of its own for the teaching of geology and experimental and applied psychology. Both these subjects are, at present, taught in the postgraduate classes, and research students are also taken in. The best way for future development of the University seems to be in gradually attempting to raise all its constituent colleges to the degree standard, teaching both B. A. and B. Sc. up to the Honours stage, and to reserve the Patna College and the Science College for post-graduate studies and research. A strong research centre, and post-graduate departments directly under the University are essential for its proper functioning. A university, after all, is a sort of club, the members of which are engaged in the creation and dissemination of knowledge. The importance of a university is gauged not by its stately buildings, but mainly by its staff and the work it turns out.

A clearer understanding of nature, life and human relations is necessary for progress of civilization, and for this concentrated research must be organized by the universities. Many of the brilliant advances of science can be described in terms of progressive discovery of smaller and yet smaller units of nature. From the atom of Democritus to the atoms of the nuclear physicist is a far cry, not only in time but also in the very character of the contrasting concepts, and a guiding principle in the long sequence of experiments which has brought us from the one to the other has been the natural philosopher's persistent desire

to find the ultimate littleness of things. In this search progress has been made at an uneven rate. In the race with the sciences, the humanistic studies are a long way behind. Viewed without relation to the reasons which have led to this result, it is a strange phenomenon, since for centuries the humanities had no competitors; they occupied in all the universities of the world the whole field of knowledge. The rise of science and the vast material expansion which has followed in its wake have, however, tended to reduce everywhere the immediate importance of cultural studies. The world to-day is scientifically minded, and scholarship as well as popular taste has simply reflected the dominant forces of the time. Men cannot, however, live by comfort and convenience alone. Adequate development of the social sciences is of utmost importance in the modern world. Without the contributions to aesthetic and cultural development which the humanities must make, the world would still remain distorted and incomplete. The fundamental interrelation of all knowledge was never more dramatically illustrated as to-day, and the fallacy of the argument for a moratorium on research in physics and chemistry was never so adequately exposed. All advancement of knowledge must wait for new ideas, fresh techniques, and more powerful instruments. In the creation of new knowledge mistakes will undoubtedly be made; hypotheses will be built up and then discarded; even facts will turn out to be facts only of the time, place and circumstance of their appearance. The pursuit of knowledge, however, will continue; it is a long climb towards a clearer understanding of nature and human relations.

To speak of research, especially in the field of international relations, in such an anxious and disillusioned hour as this may seem almost like a jest. Everywhere reason is on the defensive and we live in danger that mass hysteria will completely overwhelm it at a time when it is most needed as a safeguard. If there have always been wars and rumours of wars, never before has there existed the possibility of such material havoc and cultural disintegration. It may be, as a recent writer has said, that this arid period in which we are living is the watershed between two forms of civilization, and that the future beckons to a Promised Land more pleasing than we dream. This optimism is creditable, but for the moment, at least, the world is facing a cultural crisis in which reason is everywhere in retreat. Never has been a greater need of intelligent understanding of the social forces that are moulding the future. Such an understanding must be based on realities, and not on intuition or wishful thinking. If the problems arising out of human relations are to be solved at all, it will be through the same scientific approach to facts, made in the same dispassionate spirit of inquiry, which has given man command over his physical environment. That this course presents infinite difficulties no one will deny, but along this road lies the only ultimate hope.

# THE PROGRESS OF WOMEN'S EDUCATION IN BIHAR

*By*

MRS. R. NANDI, M. A.

Principal, Government College for Women, Patna.

The feminist movement in India has assumed such proportions that it is no longer possible to ignore it. There is much interest among women and a general desire to change the existing state of things. Various concessions have been made to them in recent years and these have taken away the momentum and force which made feminism aggressive and militant in European countries.

The word 'movement' signifies the course or process of change and it cannot be denied that India is changing and changing rapidly. She has been awakened from her age-long sleep and her women no less than her men have been roused from their slumbers almost, as it were, by the touch of a magic wand.

The women's movement in India, regarded broadly and comprehensively, may be divided into an early period of isolated efforts, initiated by individual pioneers and organisations, towards social reform and advancement of female education like the efforts of Raja Ram Mohan Roy, Keshab Sen, Mrs. Ranade and Pandita Ramabai--and the more consolidated definitely feminist movement since the twenties of the present century. Education of women is no longer a subject of controversy—to be established after weighing the good and bad points—but it is the key problem before the nation which has been accepted. Educated manhood and an ignorant womanhood is a dualism that lowers the whole level of the home and domestic life and consequently of the nation. It has been realised that it is only through proper education, consistent with the national tradition and culture and needs of modern times, that Indian women will be able to contribute to the happiness, health, and strength of the nation, thereby raising the level of its efficiency in all possible directions. We find now a great desire gradually growing in volume and intensity for social betterment of India and along with it the growth of the women's movement for better education, for greater opportunities for development and for a larger share in all the activities of life and society. These two powerful drives run parallel and help each other.

These movements synchronise with the political reforms ultimately opening up the door of independence before India. We have the privilege of being in the midst of the disruption of the old order and the dawning of a new era. Our schemes of social values are in the melting pot and new scales of judgment are

emerging. At such a juncture, even the simpler problems assume an exaggerated form, not to speak of a subject with the depth and magnitude of one like the education of a potential nation; more precisely that of the mothers of that nation.

Education in India at present is at the cross-roads. We stand before a great puzzle. It is the eternal problem facing all nations of the world. Like the great hero of the Mahabharata, we shall have to solve the great riddle of life, or we go down. Our very existence depends upon its correct solution. A great wave of mental unrest and discontent now sweeping over the country is seeking various avenues for expression in the educational field. This restlessness may, in all probability, be due to the birth-pangs of a new era in education, and consequently of a new social fabric.

In the background of this panorama of feminist movement in India the story of progress made by women in Bihar has to be set off. True, we started the race later than our sisters in other provinces—maybe that itself is the reason why we cannot enjoy the exalted feeling of self-complacency, a factor which contributes substantially to development and growth—a factor which may be connected in a causal relationship to the phenomenal growth in the number of women students in the various institutions of the province. Twenty years ago, the portals of Patna College saw the first solitary feminine figure moving up and down the college building, attending lectures more like an unwanted intruder who is there by sufferance. This atmosphere of silent hostility was the expression of a psychology that is the creation of privilege enjoyed exclusively and continuously by any one particular group and it continued for a sufficiently long time. In the course of this period women joined the College at broken intervals—when the total number of women students on the roll of the College was one or two for any academic year. And let it be reminded that that was only an exceptional feature in the life of the College very unlike the existence of a regular stream of girls—coming in and going out every year at the present time, as a matter of right. We have travelled a long way in the realm of attitudes.

Patna College, as I have observed, was the first college to have girl students. Slowly girls were taking up science, medicine or joined the Training College. By the year 1939, the need for a separate Arts College to absorb the swelling volume of women desirous to go up for higher studies was felt—in response to which the Patna Women's College under the auspices of the Avila Convent, an organization of South Indian Missionaries, sprang up. Pioneer work and very valuable work was done by this institution in this province. Subsequently, in the year 1939, provincial Government was keen to start classes for coaching students for the Intermediate Examination. Classes were thus opened with provision for teaching a few subjects. I was then myself a student of the

post-graduate class, but to give it a start offered my part-time services after attending my lectures. To-day, when I sit to review the history of women's education in this province,—which stretches itself from a very recent time indeed—I feel glad that incidentally I was connected with the very beginning of the movement. These intermediate classes were the embryonic manifestation of the full-fledged affiliated Degree College for Women at Patna—a college having its own separate establishment and teaching students up to the B. A. course in the different subjects since August 1946. Since then the total strength of the College has doubled which to-day stands at 118 as against 56 of 1946-47. The following table will help to show the distribution of women students in the different colleges at Patna :—

### NUMBER OF STUDENTS IN THE DIFFERENT COLLEGES

(1) *Patna Women's College.*

	I. A.	B. A.	Total
1940	26	—	26
1942	73	27	100
1944	134	59	193
1946	148	90	238

(2) *Government Degree College for Women, Patna.*

	1st.	2nd	3rd	4th	Total
1939-40		16			16
1940-41		25			25
1941-42		33			33
1942-43		33			33
1943-44	28	16			44
1944-45	17	20			37
1946	34	16	6		56
1947	61	37	9	11	118

(3) *Patna College.*

Year	I	II	III	IV	V	VI	Total
1942-43	2	2	7	10	2	3	26
1943-44	1	2	6	6	13	1	29
1944-45	3	1	2	6	11	12	35
1945-46	1	1	3	1	12	6	24
1946-47	4	1	6	3	8	9	31
1947	1	4	4	6	11	7	33



(4) *Patna Science College.*

Year	I	II	III	IV	V	VI	Pre-medical	Total
1938-39	1			1	1			3
1939-40	2	1				1		4
1940-41	2	2						4
1941-42	8	2	1				2	13
1942-43	10	9	1		1		3	24
1943-44	4	11	1	1	1	1	2	21
1944-45	5	5	1	1	2	1	3	16
1945-46	6	6	2	1				17
1946-47	6	4	2	1		2		15
1947-48	11	4	3					18

(5) *Patna Training College.*

## Dip-In-Ed.

1938	7
1942-43	10
1947	15

To my mind the mere increase in numbers is not so encouraging as the fact that there has been a wide diffusion of the demand for the education of women. I have accepted applications from girls living in remote interiors. It is a healthy sign of infiltration of a healthy idea and awakening to consciousness of the many. The value of it need hardly be stressed when we realize that even one weak spot in the body politic will have cancerous effects in spoiling an otherwise sound system. There should be an all-round campaign, a totalitarian drive to bring enlightenment to every one.

But the general awakening need not be sufficient in itself. It is a good sign—a refreshing symptom of the vitality of a nation. It is more the reason why now, rather than at any time before, we should consciously devote our attention to the problem of intellectual reform and rehabilitation. It is a big problem—a problem as big as the movement itself—viz. the art of canalising the movement itself. The appeal of any educational programme lies in its national setting and in the close relationship between its studies and the practical realities of home and civic life. Education must come down from the cold heights of academic isolation to the warm plains of realities. Knowledge must relate itself sufficiently closely to the practical needs of the community. For this we have to get rid of dogmas and doctrines and develop a broad and liberal outlook. With a retaining and receiving mind we need to build our future

structure on the national framework and supplement it with anything that we can profitably assimilate in our heritage of the past. This is not a purely feminine question, but surely more important than the broader issue, as women in India have always maintained a high ideal and a distinct life of their own. To continue that tradition, a policy of reform and reconstruction need be vigorously enforced—a change which will transform education to be an aid to unfold and develop the best and the noblest in woman and make her an effective citizen—a reformed system which will help her to be the mother, the maker and the silent leader in society.

# MEDICAL EDUCATION IN BIHAR

*By*

DR. B. NARAYAN M.SC., M.B., PH.D., F.N.I.

In the year 1874 a medical school was established at Patna. Its formal opening was done by Sir Richard Temple and the school was therefore named after him. After many years of dormant existence, the school received very sympathetic consideration at the hands of Sir Andrew Fraser, the then Lt.-Governor of Bengal and adequate funds were provided by him for its improvement. This school thus provided one of the earliest institutions for medical education in Bihar. Students desirous of working for a university degree in medicine, however, had to go to the Calcutta Medical College for the purpose.

After the creation of the new province of Bihar and Orissa in 1912, provincial Government arranged with the Government of Bengal to reserve 18 seats at the Calcutta Medical College for students from the province of Bihar and Orissa. The number of seats reserved, however, was not sufficient to cater for the growing needs of the province. The Maharajadhiraja of Darbhanga gave a donation of five lakhs of rupees for a Medical College in the province and in response to an appeal more donations were made available. The Medical College at Patna came into existence in 1925 with the first year class only and in July 1926, all the other classes of the College were opened and the students of the province studying at the Calcutta Medical College were admitted to those classes. The College was formally opened on 25th February 1927 by His Excellency Sir Henry Wheeler, K. C. S. I., K. C. I. E., the then Governor of the province.

The Prince of Wales Medical College, Patna, provided a six years course leading to the M. B., B. S. degree of the Patna University, the first year being devoted almost exclusively to the teaching of Biology. The College admitted only 40 students each year. With a view to provide three seats to the girl students, the number was increased to 43 in 1936. The necessity of a six years course was due to there being no provision for the teaching of Biology at the Intermediate stage under the Patna University. As soon as this was made possible, the course was reduced to five years for the students who have passed the intermediate examination with Physics, Chemistry and Biology. Since the teaching of Biology was confined only to two of the colleges in the province, viz., the T. N. J. College, Bhagalpur, and the Patna-Science College, it was felt that a course in Biology extending over a year be continued at the Science College, Patna, for the benefit of the students who did not take up Biology at the Intermediate stage. Such students had to pass an examination known as the Pre-medical examination of the Patna University before being admitted to the Medical College. Students joining the pre-medical classes were also selected for admission by the Medical College Selection Committee and had guaranteed seats at the Medical College on passing this examination.

In 1941 the number of admissions to the Medical College was increased to 48 with a view to providing seats to the students passing the Intermediate examination of the Patna University with Physics, Chemistry and Biology. There was a great demand for more admissions to the Medical College and to satisfy the needs of the province, the number of admissions was increased to 60 in 1944. This has been further increased to 80 in 1947.

The Prince of Wales Medical College, Patna, catered not only for the needs of the province of Bihar but also for those of the province of Orissa which came into existence in 1935. This College continued to admit students from Orissa till the Cuttack Medical School was raised to the status of a Medical College under Utkal University in 1944.

With the establishment of the Medical College at Patna in 1926 the medical school at Patna was transferred to Darbhanga. This institution thus replaced the old Temple Medical School and served as a very useful institution. In 1946 this school was converted to a medical college and the first batch of 60 students was admitted to this college in July 1946. Admissions to the medical school were closed but the old students were allowed to continue their studies till they passed out. It is expected that by 1949 the school students would complete their courses of studies and the institution at Darbhanga would function only as a college.

The province of Bihar has now two medical colleges which provide admission for 140 students. It is hoped that, with the expansion of the Medical College Hospitals at Patna and Darbhanga, the number of admissions each year will be increased further. There is also a great possibility for the establishment of a third medical college at Ranchi.

The local Government and the University have not forgotten the old licentiates who have qualified from the Medical School. Arrangements have been made for a condensed course to enable the licentiates to take the M. B., B. S. degree of the Patna University within a period of 2 years. This concession was made available in 1946 and up to this date about 130 students are taking advantage of this course. It is hoped this special course will be extended for some years more to enable a very large number of younger licentiates to be admitted to the M. B., B. S. degree of the Patna University.

The Medical College departments at Patna are accommodated in the same compound as the associated hospital. There are 5 separate buildings accommodating (1) the Department of Physiology & Biochemistry, (2) the Department of Anatomy, (3) the Department of Pathology, (4) the Department of Pharmacology, Hygiene and Medical Jurisprudence and (5) the College office, library and the examination hall. The hospital consists of (1) the main building housing the medical and the surgical wards, (2) the Hospital for Women, (3) the Eye and E. N. T. Hospital, (4) the Isolation

Hospital, (5) the Cottage ward, (6) the Paying wards, and (7) the Hospital for Sick Children. Besides these, there is a Radium Institute attached to the Hospital. It is the oldest institute for radium treatment in India and still attracts patients from distant parts of the country. The total number of beds in the hospital is about 700. There is also a Home for the Nurses and quarters for the Resident and House staff.

The Darbhanga Medical College has a newly built hospital and the two departments which are functioning at present, viz., the Departments of Anatomy and Physiology, are very well off with respect to accommodation.

The teaching at the Patna Medical College is being carried out as efficiently as possible. Students get sufficient attention at the practical classes and in the wards. Arrangements for the training of students in mental diseases and tuberculosis have been made at Kanke (Ranchi) Mental Hospital and at the Itki (Ranchi) Tuberculosis Sanatorium. Students are sent to these places during the college summer vacation in three batches. There are plenty of maternity cases at the hospital for women with the result that the students get full opportunity for conducting their 20 labour cases at Patna. The Hospital for Women also provided facilities for maternity cases to students from Lucknow and Lahore not long ago.

Facilities for post-graduate work and research are also available at the College. Students carry on their research work for their M. D. or M. S. thesis under the different professors of the College. By now the number of post-graduates, who have taken their M. D. and M. S. degrees of the Patna University is well over two dozen.

The Government of Bihar have been very liberal in granting facilities for higher studies abroad. After the termination of the war a large number of medical graduates have been sent abroad and a good number of officers of the Provincial Medical Service have been allowed leave and are awaiting admissions at the different universities and institutions in the United Kingdom. It is hoped that in course of the next 3 or 4 years Bihar will have a sufficiently large number of well-qualified medical graduates and specialists to take up important teaching and other appointments in the medical and public health services of the province.

Since the Prince of Wales Medical College was first started in 1928, it has made progress with respect to buildings, equipments and staff. The progress is well maintained and it is hoped that in no distant future there will be considerable expansion of the college departments as also of the Medical College Hospital so that the Medical College will rank as one of the best institutions in the country.

# RANCHI INDIAN MENTAL HOSPITAL, KANKE

*By*

DR. S. A. HASIB, M. B., D. T. M. & H. (LOND.)

The Indian Mental Hospital at Ranchi was opened in the year 1925, on the abolition of the Lunatic Asylums of Berhampore and Dacca in Bengal and Patna in Bihar and Orissa, which were amalgamated into one, with the concurrence of the Governments of Bengal and Bihar and Orissa.

The Hospital is situated at Kanke which is 5 miles away from the town and 7 miles from the Ranchi railway station. The place is connected with the town by bus service.

Kanke is about 2,200 ft. above the sea-level and is admirably suited for an institution of its kind because of its salubrious climate. The Hospital stands on extensive grounds in the open countryside and is surrounded on all sides by hills and rivers.

The Hospital is built on modern lines and is divided into two sections, viz., the Men's and Women's Sections. The Men's Section contains 10 two-storied buildings with four dormitories and eight single rooms in each of them. Besides these, there are two other buildings—one is the Infirmary and the other the Refractory Ward. The Infirmary serves as a Reception Ward, Observation Ward and Ward for the active treatment of mental and physical diseases. The Refractory Ward is meant for the agitated and restless and those patients who are likely to prove dangerous to themselves or to others. The Mens' Section provides accommodation for 1,108 patients. The Womens' Section is planned on a similar line and provides accommodation for 272 patients. The total accommodation is for 1,380 patients for the three provinces in the proportion of 75% for Bengal, 20% for Bihar and 5% for Orissa. The expenditure of the Hospital is also accordingly borne by the three governments. The Hospital is electrically installed and has adequate supply of filtered water.

The Hospital is run on modern lines and all up-to-date and modern methods of treatment are carried out, such as Psychotherapy, Pyreto-therapy, Electric Convulsive Therapy, Insulin Shock Therapy, Cardiazol Shock Therapy, Hydrotherapy, Organotherapy, Physiotherapy, Occupational Therapy and Narcoanalysis, etc. Occupational Therapy is the sheet-anchor of treatment as the majority of the patients are employed in various occupations both outdoor and indoor, such as gardening, weaving, tailoring, cane and basket making, carpentry, smithy, durree making, etc. Female patients are also suitably employed in weaving, needle and

embroidery work, lace-making, coir-teasing and mattress-making, domestic and other miscellaneous work.

There is also plenty of provision for diversional therapy, including religious therapy, for all patients who take part in various indoor and outdoor games, such as (i) Foot-ball, Hockey, Tennis, Badminton, Cricket, Rope-quoit, Teniquoit, etc. and (ii) Card, Chess, Carrom, Ping-pong, Ludo, etc. There is also a fairly big library containing suitable English, Bengali, Hindi, Urdu and Oriya books and a daily supply of several leading newspapers in English, Bengali and Hindi and monthly magazines. There is an amusement hall where patients are occasionally entertained in theatrical, magic and variety shows and also cinema talkie shows three days in a week. There are also radio-sets in both the Sections for the entertainment of patients. They also take part in dramatic performances which they organise with the help of the staff. They also take part in music for which various kinds of musical instruments are provided. The Hospital band entertains the patients every evening. The patients are also taken out to the town for motor drives and shopping, etc., twice a week. Annual sports and picnics are held for the patients. A special feature of this institution, as of any modern mental hospital, is the complete abolition of restraints in all forms, with the result that the patients are usually well-behaved, quiet and contented.

The Hospital has its own vegetable garden, which is probably one of the largest gardens of its kind, run by patients themselves under the supervision of a garden overseer and a few paid staff. The Hospital is entirely self-supporting in respect of its vegetable requirements.

Medical College students of Patna are sent here annually in two or three batches to undergo an intensive course of lectures and practical training and demonstrations in mental diseases.

There is also a temporary mental clinic attached to the Hospital in which early cases of mental diseases, which do not require certification and admission to the Hospital, are kept for advice and appropriate treatment. Only three cases can be kept here at a time.

The following table will show the percentage of recovery rates of the Hospital amongst the patients admitted for the last four years :—

	Male	Female	Total
1946-47	31.62	31.53	31.60
1945-46	32.05	37.50	33.33
1944-45	12.70	29.41	16.25
1943-44	25.32	22.22	24.53

The percentage of recovery would have been much higher had the patients been admitted soon after the onset of their illness, but unfortunately most of the patients are sent here in such a chronic state that there is hardly anything to be done for them. The public however appears to be gradually realising the importance of early treatment in the Hospital as more fresh cases now seek admission than before and the majority of such cases usually show rapid improvement and leave the Hospital fully recovered.

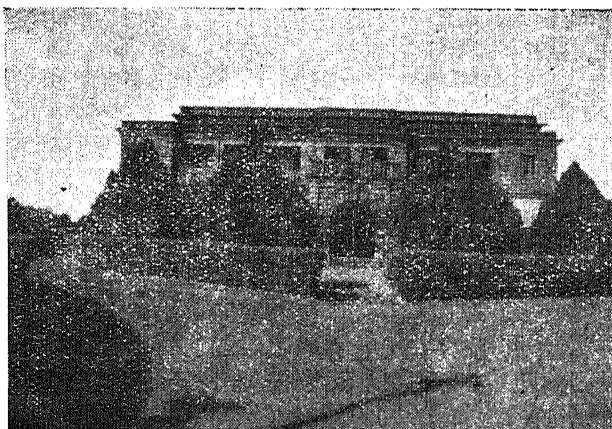


# ITKI SANATORIUM

*By*

DR. M. SINHA, M.B., B.S., T.D.D. (Wales), M.R.C.P. (Edin.)

The Itki Sanatorium was started by the Government of Bihar in 1929 for the treatment of early cases of pulmonary tuberculosis. It is situated 16 miles to the west of Ranchi town to which it is connected both by road and rail. The Itki Railway Station on B. N. Railway is only half a mile from the Sanatorium.



Itki Sanitarium

It occupies a pleasant Ranchi plateau, 2,300 feet above sea-level and covers an area of 287 acres. The climate is dry with an average rainfall of 50 to 60 inches for the whole year and most favourable for treating phthisical patients. The atmosphere is singularly free from dust and smoke and, as the Sanatorium is situated

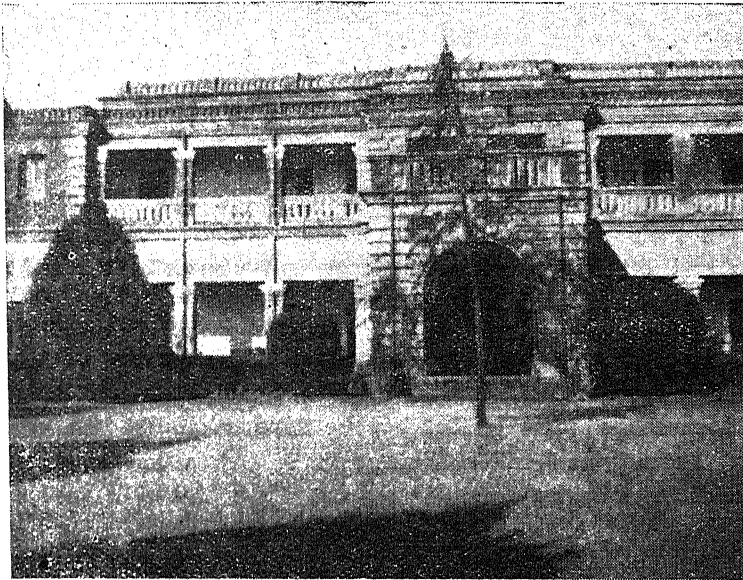
on an elevated site with good slopes on all directions, the rain water drains away very quickly. The humidity of the atmosphere in summer months is 40 per cent, while the average for the whole year is between 50 to 60 per cent. During summer the temperature remains below 100° F.; only for a few days does it go up to 103° F., but the nights are refreshingly cool. In winter the climate is very bracing and enjoyable.

The sanctioned strength for accommodation of patients in the Sanatorium is 135, but the actual attendance is always near about 170. There is a proposal pending with the Government for the increase of another 143 beds. The accommodation is classified into:—

1.	European or Special Ward	...	4 seats
2.	A Ward	...	8 seats
3.	B Ward—		
	for males	...	61 seats
	for females	...	26 seats
4.	C Ward	...	36 seats

The European Ward consists of two separate bungalows with rooms for patients and attached bath rooms and a common dining hall in each bungalow. It is fully furnished and here the patients are also provided with meals from the Sanatorium. The charges are Rs. 180/- per month.

A Ward.—Each patient is provided with a small Indian type of family quarter with inner courtyard where he can stay with his family. He has to arrange for his meals according to his tastes. The charges are Rs. 60/- per month.



Itki Sanatorium

B Ward.—Here the patient is provided with a separate cottage in which there is a separate room for the patient, kitchen and a separate bath room. The charges are Rs. 40/- per month.

C Ward.—It has two buildings containing 4 halls where the patients are kept side by side. It is very commodious and thoroughly ventilated. Their kitchens are situated at a distance from the ward. The charges are Rs. 20/- per month.

All the patients are provided with electric lights and fans and the flush system of latrines. The Sanatorium has an electrical power house of its own and also the Public Health Department to look after the underground sewerage system and water-supply to the institution.

Each patient, in addition to the accommodation, is provided with a seer of milk per day, free linen, free laundry, free barber, free medical and nursing attendance and free use of lights and fans.

The Sanatorium is equipped with a well-lit spacious operation theatre and all instruments and appliances of major surgery. There is also a well-equipped up-to-date laboratory for chemical, microscopical, biochemical and cultural examinations. There is also an up-to-date X-ray plant, ultra-violet apparatus and a dispensary. The Sanatorium stocks patent medicines and sells it to the patients at cost price without any profit and this has proved to be a great boon to the patients in the prevailing atmosphere of black marketing.

There is a guest-house fully furnished for the accommodation of patients' relations and friends who happen to come here for seeing the patients. The charge is Re 1/- per day.

The Sanatorium also possesses a Recreation Hall in which a cinema machine is going to be installed and each Ward is going to be connected with loud speakers so that the interesting programmes of the wireless, lectures and instructions can be given on the microphone from the Recreation Hall to the patients in their respective wards. There is also a radio set and a radio gramophone and other musical instruments and almost all the indoor games for the recreation and entertainment of patients.

There is a good library containing books in all the languages of the province for the use of patients. All the leading English, Hindi, Urdu and Bengali dailies, weeklies and monthlies are subscribed by the Sanatorium for the diversion of the patients. Recently an Hon'ble Minister from Orissa has given money for the purchase of Oriya books.

The disinfection of sputum is carried out twice a day in a separate building where the sputa are collected and burnt away and sputum mugs are boiled, washed and supplied to the patients. The linen of the patients are first sterilised in a Thresh Disinfector which is housed in a separate building, and then sent to the Dhobikhana for washing.

All the buildings are constructed in a methodical manner and the intervening grounds are covered with multiple flower beds and lawns intercepted by lanes and footpaths at the margin of which run well-pruned hedges in all directions.

The entire view presents such a picturesque and neat appearance that it is very soothing and refreshing to the patients.

The unique feature of the institution is that it excels every other institution of a similar type in its methodical arrangement of buildings, in its gardens, its utter cleanliness, purity of atmosphere and comforts and convenience of patients. It is also the cheapest institution where every kind of treatment is carried out for the amelioration of the sufferings of T. B. patients. It is the only institution in the country which is owned and run solely by the Government of the province.

# ART IN BIHAR

*By*

PRINCIPAL RADHA MOHAN

Patna School of Art, Patna.

It is not a matter of mere coincidence that in most of the countries of the world religion has played a most important part in giving impetus to the growth of her fine arts. History furnishes several illustrations of the power of religion in the moulding of man's aesthetic productions, and probably none of these is more striking than the effect of Buddhism on the art of the East.

Indian art may be traced as far back as about 3,000 B. C. The excavations at Mohenjodaro in Sind and Harappa in the Punjab have yielded materials which show that it was not primitive art which they practised—but art of an advanced type—sufficiently advanced to be styled the art of a civilized people, in fact, it had developed to a high degree.

From Mohenjodaro down to about 300 B. C. we do not come across materials sufficient to connect the history of art in India. It is from the emergence of the Mauryas to power in the beginning of the 3rd century B. C. that authentic and classified history of Indian art again begins, and this period may be termed as the second phase of Indian art.

The Mauryas after coming into power soon succeeded in building up a mighty empire with their capital at Pataliputra. It extended all over Northern India and was the first empire that India had built up.

In the field of art, among other things, the Maurya period may be considered as the second great landmark, after Mohenjodaro, in the history of India.

Asoka made Buddhism the state religion of the country and in his fervent devotion to the new faith, he had it propagated all over his vast dominion from the north to the Deccan in the south and even further. He ordered the erection of many pillars with edicts relating to his new faith inscribed thereon and also built numerous monasteries for Buddhist monks to reside and worship. Remains of several noteworthy pieces of sculpture in that connection, consisting of colossal stone figures intended to be guardians of entrances of buildings or monasteries, carved capitals in commemoration of religious incidents, edict pillars fixed at important spots, several rock-cut monasteries, dwelling caves and stupas of those days are available scattered throughout the whole of India. Among the finest examples extant are the Yakshi figure from Besnagar, the lion capital discovered at Sarnath and the bull capital found at Rampurva.

The great religion Buddhism having received the royal patronage gained strength rapidly and extensively. People in distant lands got attracted to the new faith; country after country came under the all-absorbing influence of the new tenet. In the words of Percy Brown:

"During this time India appears to have been the leading power throughout the whole of the East, and all Asia looked to Buddhist India for the sources of inspiration. The sacred sites in Kosala were the lode-star of the people while the sayings of the Great Teacher were becoming the gospel of every country. The absorbing nature of the Buddhist religion was mainly responsible for this supremacy, and signs are not wanting that this was India's Golden Age. Culture was stimulated, and centres of learning flourished in all parts; but in no direction was the influence of the new doctrine more pronounced than in the sphere of art—Ceylon, Java, Siam, Burma, Nepal, Khotan, Tibet, Japan and China, all testify, by the remains of their magnificent examples of sculpture, painting and architecture, to the artistic impulse of the Buddhist creed." Taranath, the seventeenth century historian, records the fact, "Wherever Buddhism prevailed skilful religious artists were found."

As the demand for more knowledge of the new religion grew, the Buddhist missionaries employed art as a most convenient and ready means of imparting the tenets of the creed to the general public. Painting and sculpture were given a new turn. The medium of art was considered to be the easiest and only feasible means for the communication of ideas to the different nations aspiring after the same ideal but possessing different language. Behar being the birthplace of Buddhism it gave rise to a Buddhist school of art comprising sculpture, painting, metal casting and things of the like. Behar with its capital at Pataliputra was made the central station, the fountain place from where men and ideas were supplied to the other preaching centres. Painters and sculptors along with missionaries were sent far and wide carrying the doctrine of the Great Teacher and using art as the vehicle of their teaching. The temple banners of Nepal and Tibet were but one of the items in the device to propagate Buddhism, these being better understood and more readily appreciated by the common people than even the simplest script. "The language of art would be a natural method of communication between different nations aspiring after the same ideal, when the more usual means of intercourse were impracticable." (Percy Brown). Carvings depicting life and preachings of Buddha, his attainments and incidents connected with his previous lives, were freely shewn on the walls of temples, stupas and other specially constructed buildings. Under this scheme bands of trained and skilful artists along with missionaries were sent to China, Japan, Malaya, Khotan to propagate the new faith. And, as it appears, most of them settled down at those places and produced frescos which bear a striking resemblance in process and technique to that of the fresco of the cave temples of Ajanta. There are indications that, along with students seeking literary knowledge, there were others who came to this Buddhist capital to study art and returned with

pictures indicating that they had undertaken courses of study under famous Indian masters of painting. These external evidences carry with them unmistakable proof of the far-reaching influence of this brilliant school of painting which flourished under the patronage of the Buddhist kings. The tragedy is that the frescoes of the Buddhist period have disappeared on account of the climatic conditions of the country but still the development and growth of the art of the East may be examined in the frescoes at Ajanta. The observations of Dr. Percy Brown on the merit of this great legacy in India is interesting. He says, "Since then, however, from a variety of causes, the frescoes have become still further obliterated, and what now remains is only an indistinct and blackened series of fragments of what was once the greatest record of painting in the East. Sufficient is left, however, to enable us to realise almost completely the full story of the Ajanta frescoes, and to understand their import in relation not only to Indian painting but to Oriental Art in general." Mr. E. B. Havell in his "Ideals of Indian Art" says, "The finest of the Ajanta paintings exhibit an amazing technical skill, a fertility of invention, and a power of expressing high religious ideals unsurpassed in any art."

The paintings in the caves extend over several centuries beginning from the 1st century A. D., thus affording examples for a study of the gradual growth of the art of painting in India, its early and mature stages. Apart from Ajanta, India in her many secluded hills and caves and spots provide enough specimens of her art. Among other places the paintings at Badami in the Bombay Presidency, Sittanavasali in South India, Bagh in Gwalior State afford interesting materials, and taken together they form the ruins of a great tradition. In the field of plastic art, the sculptures at Bhaja in the Deccan, Bharut, Sanchi, Rani Gupha in the Khandagiri Hills, and then, later on, the Mathura sculpture, the Karli caves in the Deccan, the Kanheri monastery near the Bombay Presidency, the Amaravati Stupa railings, the figures of Nagarjuni Konda in the Guntur District are all but pearls of the same garland, isolated scenes of the same drama, each distinct step of the same movement, golden rays of the same glorious rising which started at Pataliputra and shed its lustre on the whole of India, nay to the entire East, leaving behind a legacy, rich, glorious and invaluable, not to the people of Bihar alone but to the whole of India, to the whole of the East and to the whole of the world. Though the ravages of time, the cruel hands of the iconoclast, the arrogance of the vandals have wrought permanent and incalculable injury to the great achievement, the invaluable treasure-house of India, yet whatever remains have been left behind, ruined, disfigured, amply testify to the past greatness, to the rich tradition and to a highly developed state of the literary and aesthetic attainment of a time when the rest of the world was just beginning to learn. Such was the position which the Mauryas, and the Guptas gave to India by their excellent system of Government at Magadha. Writing about Patna, Dr. Sachchidananda Sinha, in the Patna University Silver Jubilee Volume, says, ".....It may be asserted that to the antiquarian, in the field of the early history of India, no place is perhaps of greater importance or interest, or calls to

mind such vast and varied associations, as the ancient city of Pataliputra—(now Patna), the hoary capital of the Nandas, of Chandragupta, and of the Great Buddhist Emperor, Asoka; indeed the earliest historic metropolis of the first Indian Empire. It was at Pataliputra that Megasthenes, coming on an embassy from Selukos to the court of Chandragupta, resided for a number of years. Megasthenes left behind him a record of his experiences which proved to be a veritable store-house of information. It was from Pataliputra that Asoka the Great issued his world-famous rock edicts, all over his vast empire—extending from Afghanistan to Bengal—and sent emissaries to preach the religion of piety in the distant lands of Egypt, Syria, and Greece. It was from Pataliputra, again, that a royal prince and princess, renouncing the majesty of royalty, went forth on a noble mission of preaching peace and piety to the distant island of Ceylon. It was also in or near Magadha that Mahavira, the founder of the Jain faith, lived and preached his doctrines. The history of Pataliputra thus begins several centuries before Christ, and as the place at which there arose not only Buddhism, but Jainism also, and as the first capital of the mightiest empire India saw in the past, it has an importance amongst ancient world-cities, which is well-nigh incomparable and unparalleled." Dr. B. B. Majumdar's observations about Patna are also interesting. He says in his "Antiquities of Patna", "Patna occupies the same place in the history of Indian culture and civilisation as was occupied by Athens in the history of Greece. The cultural life of Athens extended barely over two centuries while Patna continued to bear the torch of learning over more than a thousand years. The political importance of Patna also can be compared to that of Rome. As the western world was for the first time united under one common political authority by the efforts of Rome, so was the first great empire of India established under the hegemony of Pataliputra. If Rome is the Eternal City of the west, Patna is the immortal city of the east. Though Patna has suffered from political disasters, internal dissensions, and natural calamities from age to age, yet it has never been completely deserted and destroyed. While Nineveh, Alexandria, Pompeii, and many other ancient cities are in ruin, Patna is looking forward to a future, which may recall the glories of the Mauryan capital."

Such was the position of Patna, the imperial city of Magadha, during those days.

The two very old and widely celebrated residential universities of India, perhaps of the world—Nalanda near Behar and Vikramshila in Bhagalpur—had their seats in Magadha, the empire of the Mauryas and the Guptas.

But destiny has its way. The great march of time works in ups and downs. Nothing remains great, nothing remains powerful for all time. The picture changes. Peaceful times are gone. India now plunges into an inferno. Streams of invaders from north-west begin pouring in. Iconoclasts get the upper hand, Buddhism is now on the decline; the great incentive is gone, internecine quarrels take the place of peace. The whole atmosphere is changed. With the decline of Buddhism, the practice of fine art appears to have also declined. For nearly a thousand years

there is no extant specimen of art, at least in Northern India. The chaotic political condition in India during the period was largely responsible for this decline. The hordes from the north-western mountains now begin their depredations which soon take the form of regular invasions. The natural consequence of these disturbances was that the country could hardly produce any outstanding work of art. Bihar, too, along with its neighbouring provinces could not escape the disaster. Bihar ceased to contribute to the treasury of Indian culture. In the south the Brahmanic period showed a great tendency towards cultivation of the art, but its specimens are limited to southern India only. The sculptures at the Dash Avatar Temple at Deogarh, Jhansi District, those at Elephanta, Mahabalipuram, Tanjore, are noteworthy pieces of that period. Similarly the frescoes at Ellora, Tanjore, Cochin, Conjeeveram also deserve to be called pieces of interest and attention. But the one and principal point discernible in these sculptures and frescoes is the fact that the great tradition of Ajanta permeates the entire production of this age and as such may be safely said to be a continuity of the original line.

Now follows the age which has been referred to as the "Dark Age" of Indian history, specially with regard to Northern Provinces. From A. D. 800 to 1200 it has been stated that India has no record of any great king or empire. No notable works of art or architecture have come down to us. No great name belonging to science or literature has been handed down. A thick and impenetrable darkness hangs over these centuries over Northern India. (Dutta)

By the establishment of the Moghal dynasty in India, the chapter on fine art, which had been temporarily closed, was opened once again. The Great Moghals were themselves lovers of art and music, but being believers in a particular kind of faith, the art of sculpture did not receive their patronage. Painting however received their full support. Humayun, after his return from exile, brought with him a select set of Persian artists who, with the assistance of local Indian artists, evolved a new style of painting in India called the Moghal style of painting which may also be called the Indo-Persian style of painting—out of which arose later on the various sub-schools or 'kalam' namely the Lucknow Kalam, the Deccanese Kalam and the Patna Kalam. Indian art henceforward took a new turn: the dormant art was once again revived, though, of course, the practice of the art was limited to picture painting only.

This art of painting which developed so brilliantly in the reign of Humayun, maintained its position till the time of Shah Jehan from whose reign signs of deterioration began to appear and the final crash came in the reign of Aurangzeb.

Aurangzeb, the last of the powerful Moghal emperors, was himself a great puritan and appears to have given no encouragement to the art of painting. Artists who were once considered as the jewels of the Delhi court and who were once recipients of enormous royal favours, of royal robes and honour, now were reduced to the verge

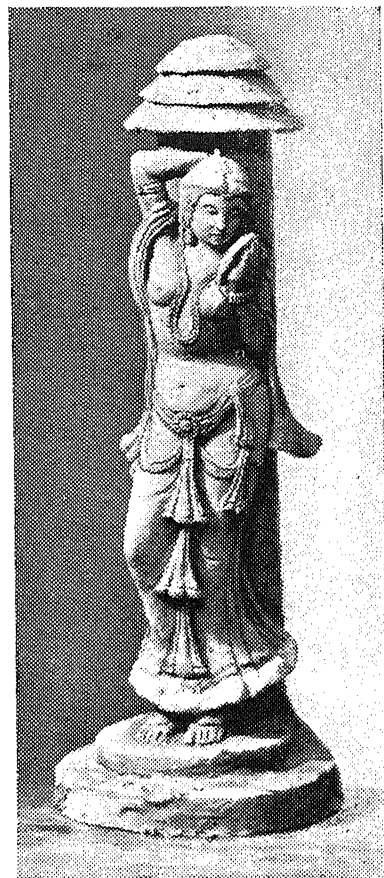


of starvation. The Delhi artists—that body forming the Delhi School of Painting—now dispersed and scattered themselves in different parts of India in search of bread and butter; some went to Kashmir, some to Oudh, some to Bengal, some to Patna, and some to the Deccan. They settled in these places and began to practise their art which as pointed out above, later came to be known as the different schools of painting.

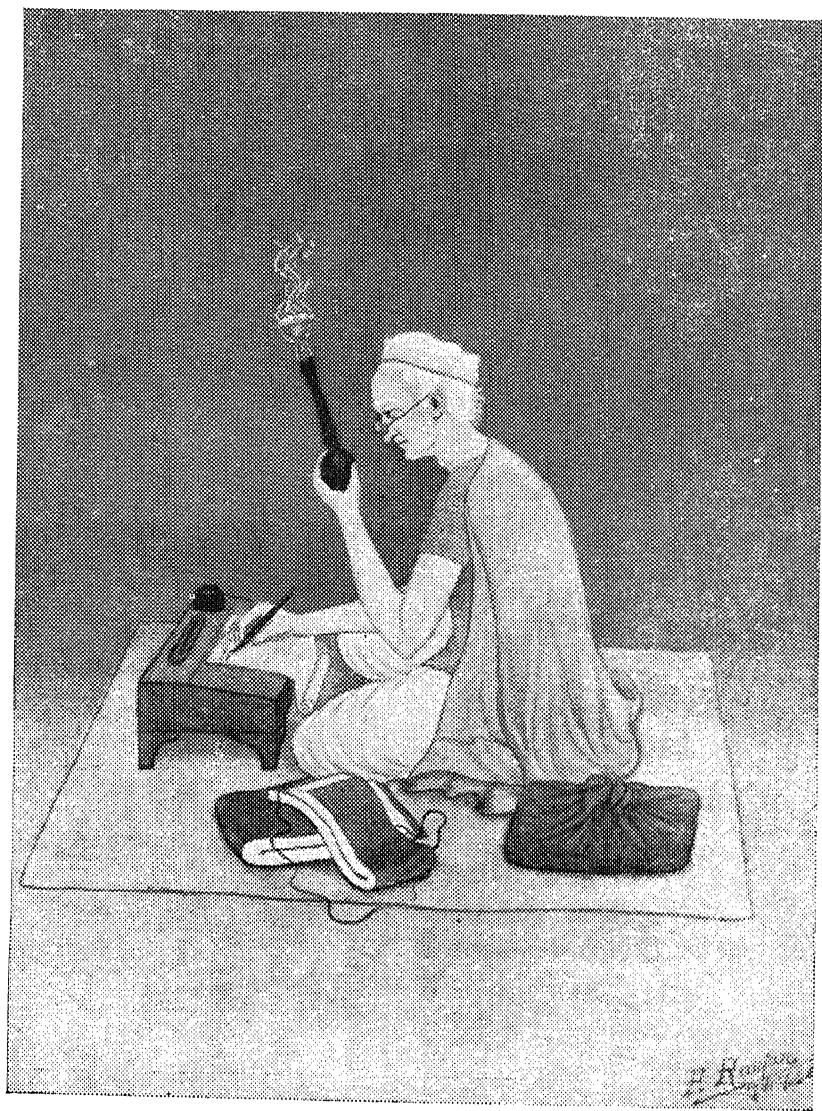
Having emerged from the one principal Delhi school, they maintained their original tradition, but as time elapsed they unconsciously drifted into their own special styles, in their schemes of colour and in the handling of the brush. In this way the different schools referred to above evolved a technique peculiar to their own. In the words of Karl Khandalavala in his "Indian Sculpture and Painting," "Some of the work of these provincial schools is indeed worthy of praise, but the glory of Moghul Art was gone for ever. The old pictures of Jahangir's and Shah Jehan's reign were copied over again with diminishing excellence."

The Patna Kalam (brush), having started much later than the other schools, tried to maintain the original technique of the Delhi and the Lucknow Schools, but could not help being affected and influenced by foreign styles. The Patna painters had their special technique, their special method of preparing colour and brushes. There was distinct originality in their treatment of subjects, their colour schemes, and their mode of execution. It was a tragedy that this brilliant school which rose so successfully could not attain to a full life and was, so to say, nipped in the very bud. Evil times befell its patrons and evil times befell this school too. Being short-lived this school was confined to a limited area in Bihar. Its members were limited and its productions were limited. In the hunt made to collect works of this style it is gratifying to note that we have come across very many beautiful specimens of the Patna style, enough to entitle the school to a distinct and elevated position among the recognised schools of painting in India and reminiscent of her olden days. A brilliant and fully representative collection of this school of painting is to be seen in the Patna Museum and in the gallery of the Patna School of Art. The last two remnants of the Patna style of painters were Babu Mahadeo Lall, the *guru* of the writer of this article, who breathed his last only about two years back, and Babu Iswari Prasad, who is still among us, having retired from the Vice-Principalship of the Government School of Art, Calcutta. Dallu Lall Jee, Babu Bani Lall, Babu Jamuna Prasad, Babu Sheo Lall Jee, Babu Sheo Dayal Jee have been noteworthy artists of this school in the past and their works are still extant. This closes the chapter of the Patna style of painting.

It is gratifying to note that Patna is again striving to regain her lost position in the domain of art. To revive the past glory of Bihar, there is already a vigorous move afoot, and a definite shape is being given to it by the establishment of the Patna School of Art at Patna in the year 1939. The movement has







the support of all lovers of art, officials and non-officials of the province. The School is indebted to the Hon'ble Mr. Anugrah Narayan Sinha, Finance Minister, and the Hon'ble Acharya Badri Nath Verma, Education Minister, Government of Bihar, who have so kindly undertaken to guide the destiny of the School in the capacity of President and Vice-President of the School. The Government of Bihar in the Ministry of Education has been supporting the School with proper and adequate aid to meet the present needs of the school and is taking steps to take the entire management of the School under their control and to run the school as a full-fledged Government School of Art in the province.

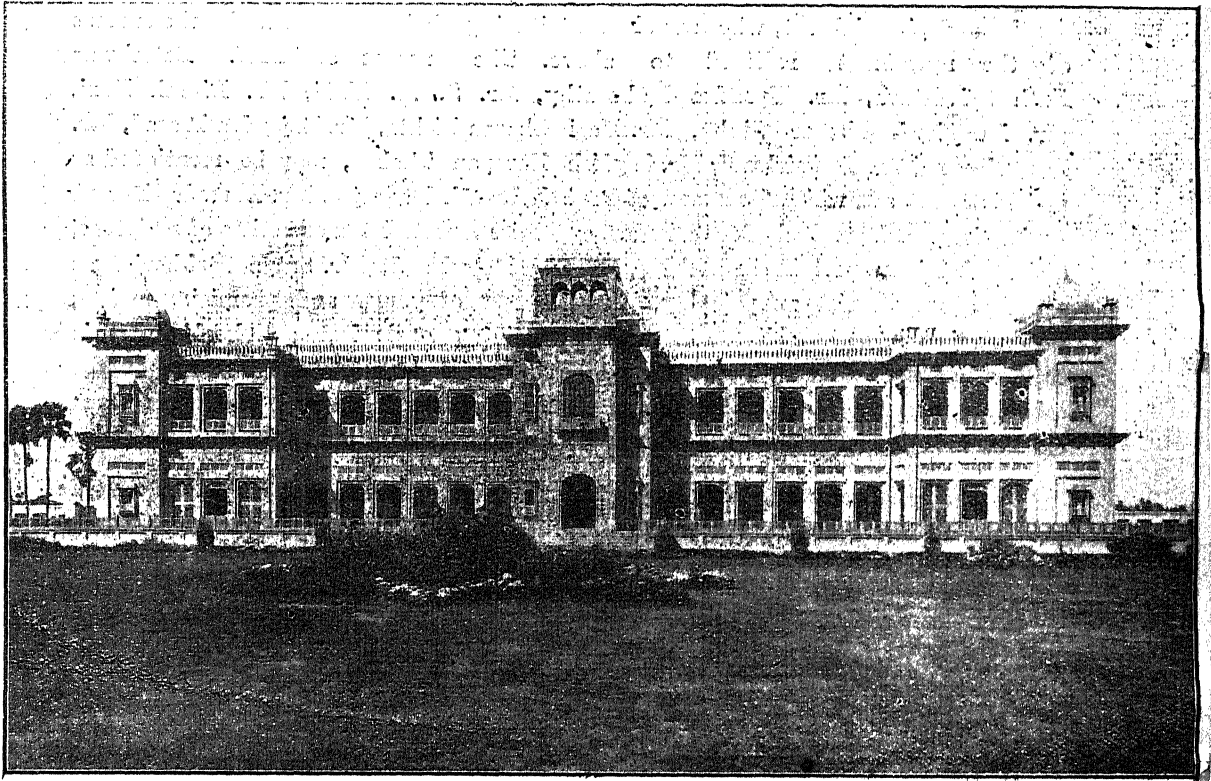
Art is already on the move in Patna. It is a matter of pride to be able to write that Patna has at present in its list, a galaxy of eminent artists, practising both plastic and pictorial art, who are all contributing their mite towards the success of the movement referred to above. The names of Prof. Bateshwar Nath Srivastava, Mr. Upendra Maharathy, Mr. S. M. Hadi, Mr. Dinesh Baxi, Mr. Awadhesh Kumar Sinha, Mr. Hari Charan Mehta, Mr. Rajendra Prasad, Mr. Rameshwar Prasad Jaishwal, Mr. Jagdish Narayan Thakur, may be mentioned as artists of fine art, while the names of Prof. Jadunath Banerjee, Mr. Damodar Prasad Ambastha, Mr. Ram Bahadur Mander, and Miss Aneeta Dass as artists of sculpture, and Prof. Bishwanath Prasad Khare, Mr. Shyamala Nand, Mr. Satya Mukherjee as artists of commercial art painting. Another set of young and promising artists, who are just in the making and receiving training at the Patna School of Art, is to take up the field very soon. Some of the work done by the students of the school, representing both pictorial and plastic art, as well as some specimens of the old Patna Style of Painting, are reproduced here for the interest of the readers.

In the end I may conclude my article by saying that a great future lies for this province of Bihar and in the words of Mr. Samaddar, "If Magadh was great, Bihar has to be greater."

## LOCAL INSTITUTIONS

### The Patna Museum.

The unearthing in 1912 of the 23-centuries-old multi-pillared Mauryan Palace at Kumrahar, only two miles from Patna, and the excavation, two years later, of the famous monastery of Nalanda roused unprecedented enthusiasm in the province. The need of a building which could house and preserve its priceless archaeological treasures was keenly felt and this led to the formal establishment in 1917 of the



Patna Museum.

Patna Museum. The exhibits were housed at first in the Commissioner's Bungalow and shifted later to the north wing of the Patna High Court. The new building on the Patna Gaya Road, which was opened in 1929, is a fine example of the Indo-Saracenic art and is well worth a visit.

Besides the implements of the Stone Age and the Copper Age, it contains many unique specimens of art illustrating different periods of Indian history. Represent-



ing Maurya art are the Didarganj Yakshi image, the pillars and capitals excavated at Kumrahar, Bulandibagh, and several other objects. Gupta art is illustrated by the colossal Vishnu image (north of the building) found at Masarh (Shahabad). There are numerous works illustrating art in the Pala and Sena periods, e.g. Tara image (Hilsa), and Haskrakol (Gaya) images. The terracotta collection is very rich, being drawn from Mathura, Kausambi, Bihta, Rajgir, Vaisali, Bodh Gaya (plaque), Buxar, Pataliputra (Laughing Boy and Laughing Girl), covering pre-Mauryan to Gupta periods. But the richest collections in the Museum are the bronzes and the coins, e.g., the bronzes from Kurkihar (5th cent. B. C. to modern times). The influence of the Eastern School of Art on Tibetan art is illustrated by the Tibetan Temple banners. As regards inscriptions, the Museum possesses the stone inscription of Vishnugupta of Magadha (c. 700 A. D.) which is the first available inscription of this king, and many copper plates (6th-15th cent. A. D.)

There are beautiful examples of Mughal, Rajput, Kangra, Baholi, and Chamba paintings, and works by artists of the Patna School on paper, mica and ivory. Outstanding art treasures are Persian manuscripts, a copy of the Shahnama, the Tibetan MS. copy of the Prajnaparamita, one set of ancient armour, and Persian tiles.

### **The Sreemati Radhika Sinha Institute and the Sinha Library.**

The Institute was set up by Dr. Sachchidananda Sinha in honour of the memory of his wife, Sreemati Radhika Debi, and was opened in 1924. It has a research room with bound volumes of some important Indian newspapers and periodicals, while the reference section of the Library contains the latest editions of encyclopaedias, dictionaries, and other works of reference. Its nucleus was the extensive private collection of Dr. Sinha, and now this "one man's library" has grown into a public institution and an important intellectual and cultural centre between Calcutta and Allahabad.

### **The Khuda Bukhsh (Oriental Public) Library.**

It contains a choice and fine collection of manuscripts in Arabic and Persian, magnificent specimens of calligraphy, and rare illuminated manuscripts, besides a few well-selected objects of oriental art. It was founded by the late Khan Bahadur Khuda Bukhsh, C. I. E., (1842-1908), Government Pleader, and sometime Chief Justice of the Nizam's High Court, Hyderabad. His mortal remains, as also those of his son Shahabuddin, are buried within the Library premises. The Library was opened with 3,000 manuscripts (Arabic and Persian) and 2,000 books in English and other European Languages in 1891. The Library now contains about 26,000 books (Manuscripts: 6,522; printed: 19,461).

### **The Patna Blind School.**

The Patna Blind School was founded in the year 1922 by Mr. Baikuntha Nath Mitter, Advocate, Patna High Court, and was subsequently registered under Act 21 of 1860. The present buildings at Kadam Kuan were constructed in the year 1930 with the Government grant and subscriptions raised from the public and the opening ceremony was performed on the 17th November, 1930. Tallents Hall, the gift of Mr. P. C. Tallents, C. S. I., C. I. E., I. C. S., who was for some time the President of the Managing Committee of the School, was opened by Lady Hallett on the 28th January 1938 for the pursuit of industrial works.

The object of the school is to impart to blind boys from 6 to 12 years of age suitable training so that, instead of being burdens to their society, they may be useful citizens. They are given training in literary, industrial and musical subjects, both vocal and instrumental, and are also taught typewriting, gardening and nature study and cooking. Industrial education comprises basketry, wickerwork, manufacture and repair of cane furniture and rope-making. Manipulation of carpentry tools is taught to help the pupils in trade. Physical education is also imparted to the boys and the school has a set of gymnasium apparatus. The Patna Blind School Scout Troop was registered as a unit of Bihar Provincial Boy Scouts Association in the year 1932.

Suitable candidates are prepared for the Matriculation Examination of Patna University. Some of the students after passing the Matriculation Examination have graduated from the Patna University. A few who passed out from the school are teachers in Blind Schools outside the province.

The school is being maintained with the income from the interest on Endowment Fund and Government and Municipal grants and subscriptions from the public.

### **Government Tibbi School, Patna.**

This institution was established on an experimental basis in the year 1926 by the Provincial Government for teaching the science of Tibb-e-Unani, the indigenous system of medicine, on modern lines, and was placed on a permanent footing in April 1942.

Training, both theoretical and practical, is imparted to the students. The subjects taught at this institution include both ancient and modern sciences. The medium of instruction is both Arabic and Urdu.

There is an outdoor hospital (Shafakhana) attached to this school where students receive practical training in case-taking and prescriptions. Practical training in surgery is also imparted at the Shafakhana, where there are arrangements for performing minor operations under the supervision of two qualified doctors. The



daily attendance of patients (of all kinds of diseases) at the Shafakhana is over 300. They are examined, treated and supplied with medicines free of any charge.

The course of study at this institution extends over a period of four years. Two examinations, preliminary and final, at the end of the 2nd year and 4th year respectively, are held and conducted by a Board ; and the degree of Graduate of Unani Medicine and Surgery is conferred on students who pass the Final Examination.

So far about 212 Hakims have qualified themselves from this institution. Almost all of them are carrying on their practice quite successfully in the various parts of the country and some of them are in service under the Government, District Boards, municipalities and private estates of the province.

### **Bihar Research Society.**

The Bihar and Orissa Research Society, now the Bihar Research Society on account of the separation of Orissa from Bihar, owes its origin to the initiative of Sir Edward Gait, a former Lieutenant-Governor of the province. The Society



Rev. Rahul Sankrityayan

was started in 1915 with the object of promoting research in the province in History, Archæology, Numismatics, Anthropology and Philology, and its quarterly

journal, which is now in the thirty-second year of publication, has secured wide recognition amongst the learned societies of the world.

Amongst outstanding achievements of the Society, mention may be made of the systematic search for Sanskrit manuscripts for the last 27 years in Mithila and Orissa and the securing of nearly 200 Sanskrit texts from Tibet in 1935 by the Rev. Rahula Sankrityayan.

### **The Qila House and the Jalan Collection.**

Prettily situated on the site of the old fort of Sher Shah at the eastern extremity of Patna City and rising sheer from the waters of the Ganges is the magnificent residential house of Dewan Bahadur Radha Krishna Jalan, who is one of the most eminent collectors of curios in India and a great patron of learning. The Jalan Collection contains a large and varied range of interesting curios and objects of art, including jade, porcelains, paintings, tapestry, antiques of gold and silver, old furniture, coins, sculptures, manuscripts, etc. The collection of Chinese jade of periods ranging from *Chou* and *Han* periods down to mediæval times, is perhaps the best of its kind in India. Mention may be made of the fine set of 12 bronze and wood-carved images from Nepal and Tibet, depicting Buddha, Manjushri, Indra, etc., and the representative specimens of coins from early times to the present day. The library contains several well-preserved old manuscripts in Sanskrit, Maithili, Tibetan and Persian, some of which date from mediæval times.

### **Cottage Industries Institute, Gulzarbagh.**

This Institute is the result of the expansion and development of the cotton experimental and testing station started at Ranchi in 1922. It was formally opened in its present form in 1925. The Institute is run on commercial lines and under workshop conditions and offers opportunities to young recruits to learn trades and handicraft in environmental conditions approximating to those obtaining outside. The Institute comprises the following departments :—

- (1) Cotton-weaving and spinning; (2) dyeing and calico-printing; (3) knitting; (4) weaving of carpet, durrie, newar, tape, etc., (5) toy-making; (6) pottery; (7) tailoring; (8) cane furniture and basket manufacture; (9) paper-making.

The various departments are housed in spacious buildings originally intended for the opium factory of Patna. The duration of training is two years in the case of cotton-weaving, dyeing and calico-printing and tailoring, and one year for the other courses. There is an efficient staff and the medium of instruction is Hindi and Urdu.

**The Hindustan Bicycle Manufacture Corporation Limited, Phulwarisharif, Patna.**

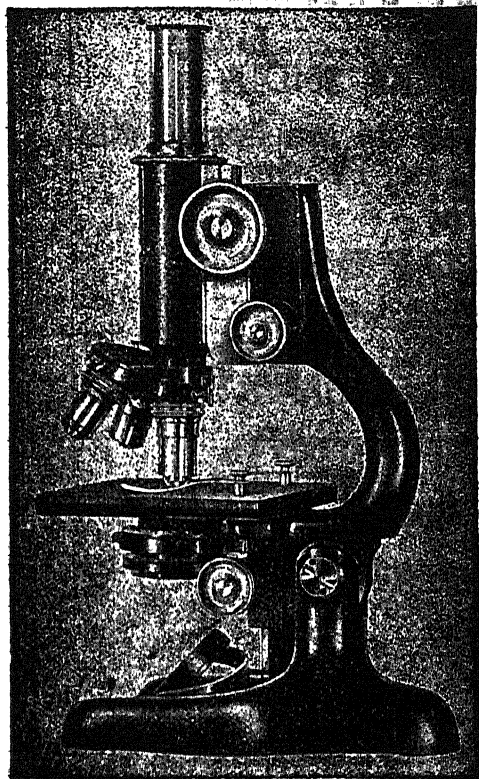
The Hindustan Bicycle Manufacturing & Industrial Corporation Ltd. is the pioneer industry in this country manufacturing complete cycles, and is being run under the able guidance of Rai Bahadur Syamnandan Sahaya, C. I. E., M. L. A., who is Chairman and Managing Director. It employs over 1,000 workers, including a large number of skilled labour.

The Corporation is situated at Phulwarisharif in the province of Bihar and is a few miles from its capital.

The average production of the Corporation is about 1,500 to 1,800 cycles per month, including a fair quantity of spare parts. Apart from cycles, the Company manufactures tricycles, perambulators, household and drink trolleys and various other household equipment. There is one By-Product Department, which manufactures various types of stationery requisites and articles of common use like knitting needles, door handles, toast racks, napkin rings, etc.

The management is visualizing further increase in production with the return of normal labour conditions, so that the production cost may be reduced and the cycles made cheaper. They are making arrangements for the import of further machinery, which will also speed up the production. The aim of the manufacturers is to produce cheap and durable cycles so that the common man may be able to buy one.

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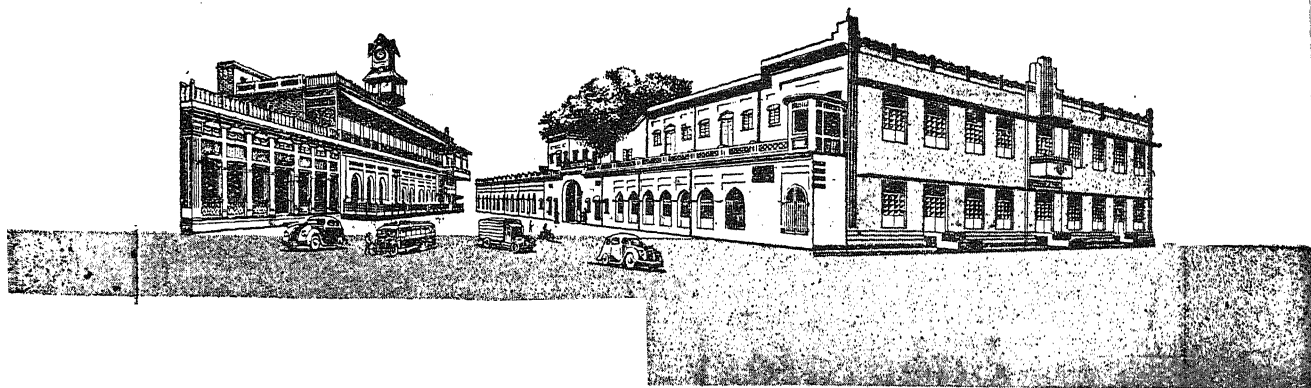
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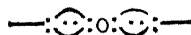
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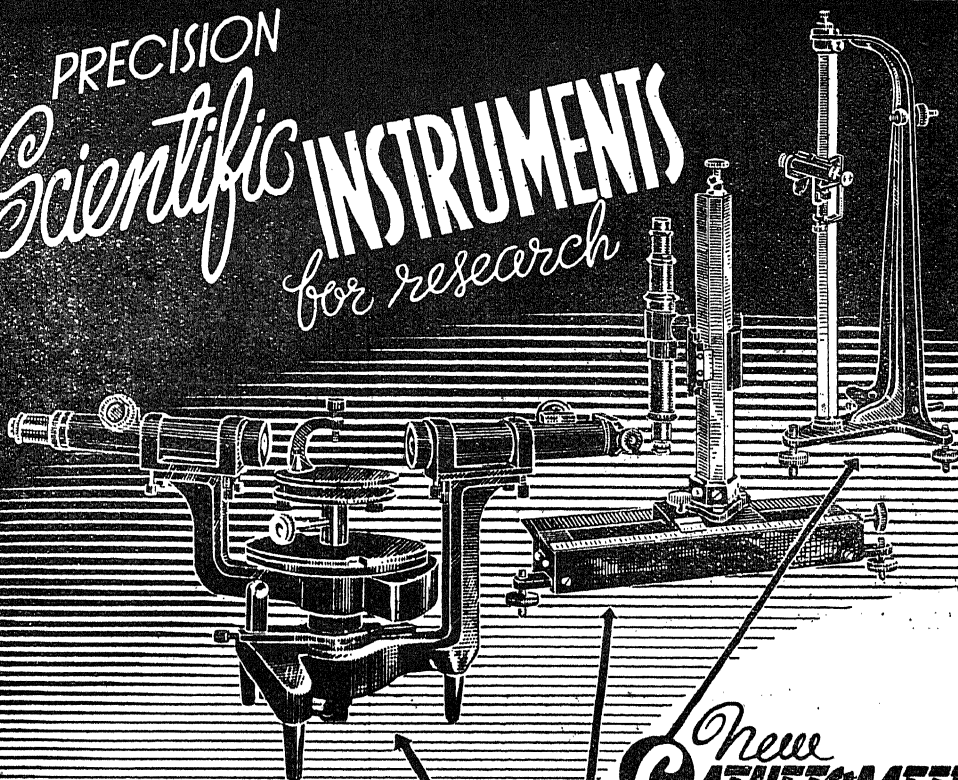
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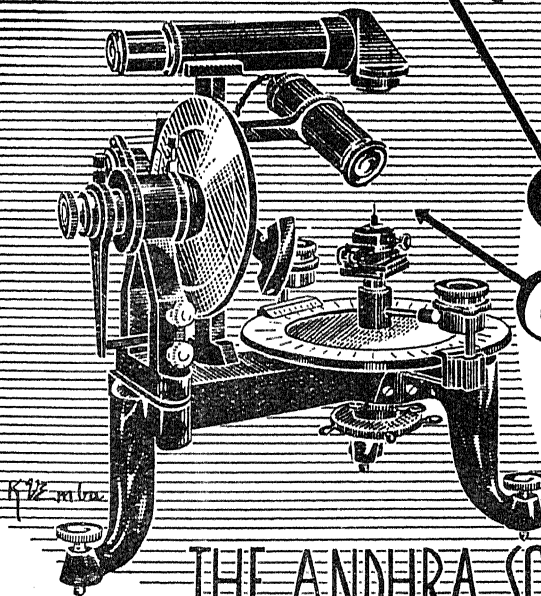


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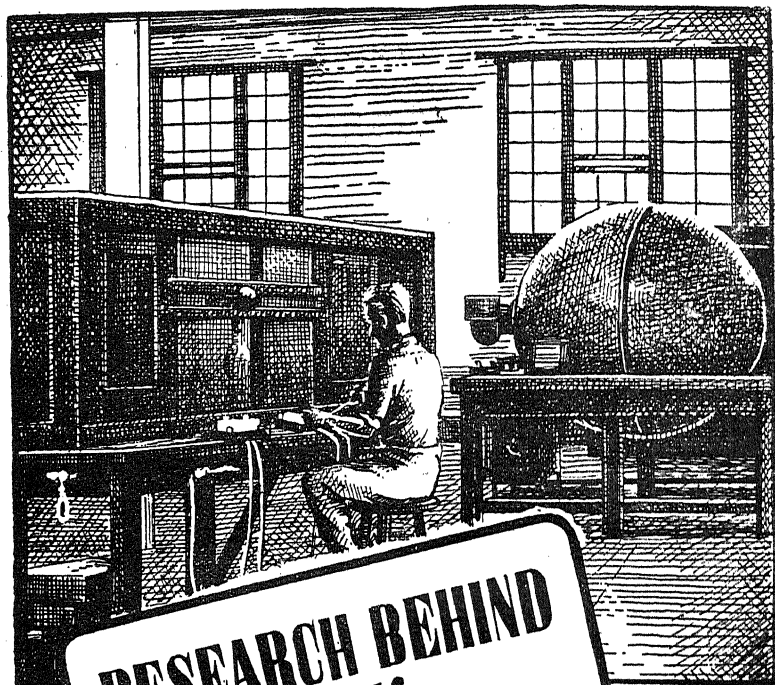
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